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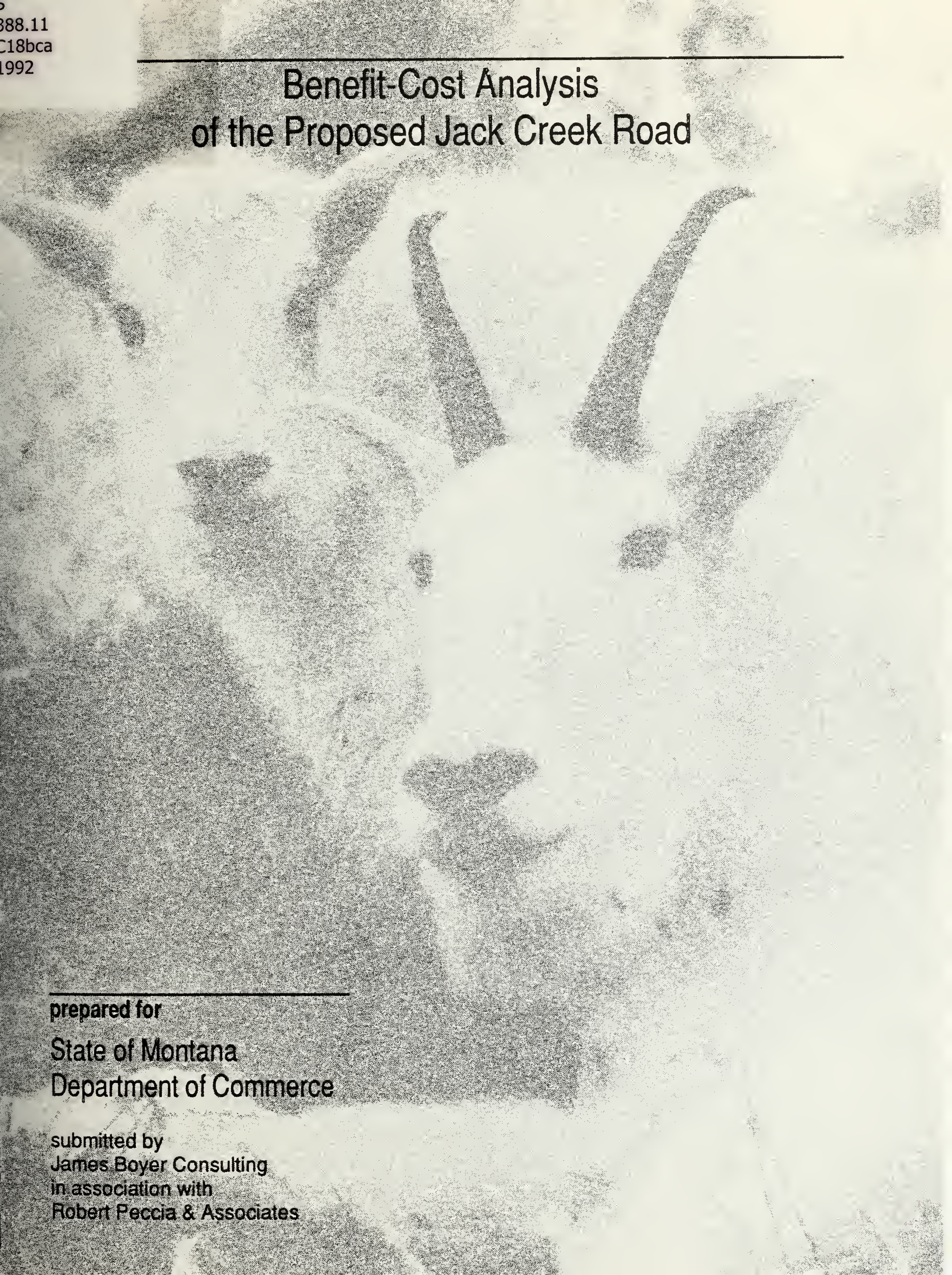
Benefit-Cost Analysis of the Proposed Jack Creek Road



prepared for

State of Montana
Department of Commerce

submitted by
James Boyer Consulting
in association with
Robert Peccia & Associates

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May 15, 1992

Andy Poole
Deputy Director
Montana Department of Commerce
1424 Ninth Avenue
Helena, Montana 59620

Dear Mr. Poole:

Enclosed are 2 copies of our report on the proposed Jack Creek Road. The report is in three sections: an estimate of the cost of building and maintaining the road under two assumptions about the design standard; an analysis of the economic impacts of the road on Ennis and Madison County; and, a benefit-cost analysis of the project.

As noted at various places in the report, additional information should be gathered before using the conclusions of the report for decision making. In particular the impacts of the road on wildlife, and other external environmental affects of the road, have not been quantified for inclusion in the benefit-cost analysis. Some indirect benefits, that may be important to the decision, also were not estimated for this study. For example, a possible reduction in accidents in the Gallatin Canyon might turn out to be a significant factor in a decision on the road. We recommend that such factors be considered as part of any EIS or other analysis before a decision is made.

We are particularly appreciative for the help we received from Jan Clack, Gail Brockbank, Patricia Roberts, Dave Martin, Pam Harris, and Jim Williams of your staff. We hope that the report meets your expectations. We would be happy to discuss the contents and conclusions of the report with you. This report satisfies our obligation under Contract No. 92-61-0001.

Sincerely,

Boyer
James Boyer

Larry Nordell
Dr. Lawrence P. Nordell

Shawn L. Foutch
Shawn Foutch

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INTRODUCTION

The purpose of the Jack Creek Road Benefit-Cost Study is to:

1. Develop cost estimates for constructing, operating, and maintaining a Jack Creek Road which would provide a high level of service between Ennis and Big Sky, Montana;

2. Forecast the local economic impacts of the road. This analysis includes estimates of the short- and long-term effects on local employment and income; and,

3. Complete a benefit-cost analysis of the road which compares the long-term benefits to be gained if the project is built with the costs of carrying out the project.

This document consists of three summary reports and three supporting technical reports. Shawn Foutch of Robert Peccia and Associates is the principal analyst and author of road cost estimates, Jim Boyer is main preparer of the local economic impacts sections, and Dr. Larry Nordell is the main preparer of the benefit-cost studies. The three project components are interdependent. Mutually developed assumptions and information are shared by engineering, economic, and benefit-cost studies.

Two different road design alternatives were examined. The emphasis of this report is on the" Desirable Road Design." This road would provide the highest level of service, would have the most positive economic impacts on Madison County, and would result in the most favorable benefit-cost ratio. The "Desirable Design" would also have the greatest likelihood of being accepted into the state highway system.

TABLE OF CONTENTS

SUMMARY REPORTS

page
Detailed Table of Contents.............................. 2

- Summary Report 1
  Cost Estimates for the Jack Creek Road................. 3
- Summary Report 2
  Local Economic Impacts of the Jack Creek Road.......... 5
- Summary Report 3
  Jack Creek Road Benefit-Cost Analysis.................. 10

TECHNICAL REPORTS

- Technical Report 1
  Jack Creek Road Cost Estimate.......................... 17
- Technical Report 2
  The Economic Impacts of the Jack Creek Road............ 34
- Technical Report 3
  Jack Creek Road Benefit-Cost Analysis.................. 84

SUMMARY REPORTS

TABLE OF CONTENTS

Page

1. COST ESTIMATES FOR THE JACK CREEK ROAD........................3

2. LOCAL ECONOMIC IMPACTS OF THE JACK CREEK ROAD..............5

3. JACK CREEK ROAD BENEFIT-COST ANALYSIS.......................10

TABLE OF TABLES

S-1 Summary of Employment and Earnings Impacts of the Jack Creek Road, "Desirable Road Design"................................6

S-2S Summary of Employment and Earnings Impacts of the Jack Creek Road, "Minimun Road Design"....................................9

S-3 1989 Skier-day Allocation Benefits.........................12

SUMMARY REPORT 1
COST ESTIMATES FOR THE JACK CREEK ROAD

The subject of this project is a road connecting Ennis, Montana and the Big Sky ski resort, through the Jack Creek drainage basin. A connection between these two points already exists along Jack Creek, but is not suitable for public use. This study estimates the costs to improve the route to acceptable standards.

The existing roadway consists of about 13.3 miles of private, one-lane, dirt logging road, 9.6 miles of two-lane gravel county road, 0.9 miles of two-lane hard-surfaced county road, and about one mile of paved state highway. The route is about 24.8 miles long, and requires slightly more than one hour to traverse in good weather. The private section of road is closed to the public. The rest of the route is maintained for minimum public access to local private lands and the recreational attractions along Jack Creek.

Conceptual designs for the proposed roadway are based on typical Montana highway standards for mountainous areas. Since the exact roadway needs are not known at this time, two versions of the design are evaluated in this study. A "Minimum Design" is evaluated to indicate the lower end of expected costs, and a "Desirable Design" indicates the upper end of expected costs.

Conceptual designs were developed for the route by using terrain data from USGS topographic maps, a video tape of the existing roadway, and point coordinate data for the existing roadway. Both the video tape and point coordinate data were obtained by volunteers, and provided to the consultant.

The conceptual designs were evaluated to obtain quantities for earthwork, paving materials, drainage facilities, and other related components of the proposed construction. Costs were estimated by applying unit prices to each of the identified quantities. Unit price data was obtained from Montana Department of Transportation Bid Tabulations of roadway cost data for 1991.

The roadway designs evaluated in this study are based on 40 mile-per-hour and 50 mile-per-hour design standards for Montana primary highways. Both designs call for two paved 12-foot-wide traffic lanes, and paved shoulders. Shoulders are eight-feet-wide for the desirable design, reflecting the perceived need to accommodate stopped traffic for emergencies and other purposes. The minimum design calls for three-foot-wide shoulders, reflecting a design standard that was used for Montana route P-64, which provides access to Big Sky from highway 191 from the east.

A paving section was defined based on typical highway construction materials and thicknesses. It was assumed to consist of four inches of asphalt material over 14 inches of high quality gravel.

Because of design controls imposed by design speed, the minimum design route is estimated to be about 22.5 miles long, requiring about 35 minutes travel time in good weather. The desirable design route is estimated to be about 21.0 miles long, requiring about 25 minutes travel time in good weather.

According to this study, the minimum cost that could reasonably be expected to construct this roadway to minimum design standards is about $17,000,000. The cost to construct to the desirable standards outlined in this report is estimated to be about $21,500,000. If higher design standards are desired, the actual cost would exceed this upper limit.

Annual operation and maintenance costs were estimated using average lane-mile costs for similar roadways, obtained from the Montana Department of Transportation, Maintenance Bureau. In addition, costs for continuing pavement management were included in the annual O&M estimate. The proposed pavement management plan calls for resealing the roadway surface at 7 years, providing a 0.3' overlay at 14 years, and resealing again at 20 years.

The technical report included later in this document provides more detailed information on the methods and assumptions used to arrive at these cost estimates. Detailed calculations, maps, cross sections, and design notes supporting the conceptual designs in this report are also available for reference.

SUMMARY REPORT 2
LOCAL ECONOMIC IMPACTS OF THE JACK CREEK ROAD

The construction of the Jack Creek Road would have positive impacts on the Madison County and Gallatin County economies. Once in operation, the road's primary transportation function would be to deliver western Montana residents to and from Big Sky. The road would continue to produce positive economic benefits in the Madison County-Ennis area. However, much of this long-term economic benefit would be at the expense of the Gallatin County economy.

The Jack Creek Road would encourage a significant number of Big Sky workers to relocate their homes in Madison County. The move would shift Big Sky worker expenditures from Gallatin to Madison County businesses. The new road would also cause Big Sky residents and visitors to move some of their shopping, dining, and recreation to the Madison Valley. In addition, the road would create a new preferred travel route from western Montana communities to the Big Sky ski hill. Traveler expenditures previously made in the U.S. 191-Gallatin Canyon-Meadow Village corridor would be shifted to businesses along U.S. 287 and in Ennis. These effects would increase employment and income in Madison County. Albeit to a small degree, they would also decrease employment and income in Gallatin County.

The road could lower travel time to Big Sky from western Montana skier markets. This could cause an increase in the number of skier days at the resort. Some of this growth would be at the expense of rival in-state ski areas. Bridger Bowl, which is also in Gallatin County, is the rival ski resort which would be most affected by the new road. Additional expenditures by Montana residents at Big Sky would likely cause decreases in expenditures elsewhere in Montana.

The road would not result in an significant increase in out-of-state visitors to Montana. The Big Sky resort markets most successfully to markets in the central and eastern U.S. Most out-of-state car travelers to Big Sky would continue to access the resort via the Gallatin Canyon. Likewise, plane visitors would arrive at the Bozeman airport and would continue to access Big Sky via the Gallatin Canyon. It is possible that some out-of-state visitors would extend the length their visits to Montana because of better access to the attractions of the Madison Valley. This increase in visitor days would be minor.

The Jack Creek Road would not provide for more efficient travel to destinations other than Big Sky, and would have little effect on travel or commerce between other Montana communities.

The following table allows for a comparison of the local economic impacts of the Jack Creek Road in Madison and Gallatin counties for the "Desirable Road Design." Projections for the "Minimum Road Design" are located at the end of this summary section.

Table S-1
Summary of Employment and Earnings Impacts of the Jack Creek Road "Desirable Road Design" for Selected Years 1994-2015

MADISON COUNTY

	Employment Impacts (Number of Jobs)					
	1994	1995	2000	2005	2010	2015
Road Construction	31	31				
Worker Relocation			119	133	148	162
Lodging in Ennis			2	5	6	6
Day Trips from B.Sky			6	7	8	9
New Rec. Homes			15	17	19	21
New Seasonal Resid.			7	14	24	32
Cross Commerce			5	5	5	5
Drive-through Traf.			1	1	1	1
Total Employment	31	31	155	182	211	236

MADISON COUNTY

	Earnings Impacts (in millions of 1992 $)					
	1994	1995	2000	2005	2010	2015
Road Construction	$0.479	0.479				
Worker Relocation			1.783	2.000	2.217	2.435
Lodging in Ennis			0.036	0.073	0.081	0.090
Day-Trips from B.Sky			0.096	0.107	0.119	0.131
New Rec. Homes			0.250	0.280	0.311	0.341
New Seasonal Resid.			0.635	1.353	2.324	3.036
Cross Commerce			0.076	0.075	0.074	0.070
Drive-through Traf.			0.011	0.012	0.013	0.014
Total Earnings	$0.479	0.479	2.887	3.900	5.139	6.117

GALLATIN COUNTY

	Employment Impacts (Number of Jobs)					
	1994	1995	2000	2005	2010	2015
Road Construction	43	43				
Worker Relocation			-136	-152	-169	-186
Day-Trips from B.Sky			-8	-10	-10	-12
Cross Commerce			-7	-7	-7	-7
Drive-through Traf.			-1	-1	-1	-1
Total Employment	43	43	-152	-170	-187	-206

GALLATIN COUNTY

	Earnings Impacts (in millions of 1992 $)					
	1994	1995	2000	2005	2010	2015
Road Construction	$0.778	0.778				
Worker Relocation			-2.039	-2.287	-2.535	-2.784
Day-Trips from B.Sky			-0.126	-0.144	-0.157	-0.172
Cross Commerce			-0.105	-0.105	-0.102	-0.102
Drive-through Traf.			-0.013	-0.014	-0.016	-0.017
Total Earnings	$0.778	0.778	-2.283	-2.550	-2.810	-3.075

Total Employment and Income Effects 1994-2015

The combined effects of road construction and operation are projected to add 3,742 person-years of employment and $82 million dollars in personal earnings and income to the Madison County economy. During the same period the road would reduce employment in Gallatin County by 3,354 person-years and personal income and earnings by $48 million.

Short-term Impacts 1994-1995

The estimated cost of building the road is $21.5 million. The road's construction would directly create jobs and income for persons working on the construction project, and indirectly create jobs and income for people providing goods and services used in construction activities. Expenditures by persons involved in project construction would cause secondary economic effects, also creating jobs and income.

Road construction is projected to generate an average of 31 jobs and $479,000 in personal earnings for Madison County residents and 43 jobs and $778,000 in annual earnings for residents of Gallatin County. These impacts would occur during both years of project construction. An estimated 81 on-site construction jobs, and 117 indirect and secondary jobs would go to residents of other areas of Montana.

Road construction would have a net positive impact on the Montana economy if funding were from revenues which would otherwise not be spent in the state. If building the Jack Creek Road consumed funds which would otherwise be spent for other Montana projects, the Jack Creek construction project would simply relocate economic benefits from one geographic area to another.

Long-term Impacts 1996-2015

Madison County:
The Jack Creek Road would have noticable long-term impacts on the Madison County economy. For the 20-year study period, the road is estimated to generate an annual average of 215 jobs and $4 million in personal income. The road would cause a 5 percent increase in county-wide employment and a 4 percent increase in total personal income of county residents.

Once in operation, the Jack Creek road would create a year-round travel link between Ennis and Big Sky. The new road would allow Ennis area residents to commute to jobs in Big Sky, and many Big Sky, Bozeman and Gallatin Gateway residents employed at Big Sky would relocate to the Madison Valley.

The employment of Ennis residents at Big Sky would add to the economic base of the Ennis-Madison County economy. Local expenditures by persons working at Big Sky and living in Ennis area would create income and jobs in businesses in Madison

County. For the 20-year study period, the direct and secondary effects of worker relocation would add an average of 135 total jobs and $2 million dollars a year in earnings to Madison County.

Selected Ennis area businesses would also benefit from local expenditures by drive-through skiers and skiers using Ennis for overnight lodging. Expenditures by these primarily in-state residents would add stimulus to Ennis's sluggish wintertime economy. During the 20-year study period, the direct and induced effects of these expenditures add an average of 5 jobs and $74,000 dollars a year in earnings to Madison County's economy.

The road would also allow for increased commerce between Ennis and Big Sky. At least in the early years of the road's use, this commerce would mainly benefit Madison Valley businesses. Big Sky visitors and residents could be expected to make day trips to the Madison Valley for shopping, recreation, dining, and entertainment. Their expenditures are projected to add an average of 12 jobs and $183,000 a year to Madison County. Irrespective of a Jack Creek Road, Big Sky residents will continue making most non local purchases in the Bozeman.

The road's development could also facilitate additional real estate development in the Madison Valley. The Ennis area is too far from Big Sky to attract full-blown ski-condominium development, but access to Big Sky skiing could further encourage construction of recreational homes in the area. Construction of additional homes is projected to add an average of 17 jobs and add $283,000 in annual earnings to Madison County.

The new recreation homes would also increase the population of the Madison Valley. Local expenditures by new home occupants would add an average of 15 jobs in local businesses and $1.5 million county-wide income (this increase in personal income is mainly the income of persons living in the recreational homes).

Gallatin County:

Gallatin County will continue to experience population and economic growth irrespective of development of road through the Jack Creek Canyon. The Jack Creek Road would result in the transfer of some existing and future jobs to Madison County, causing a small decrease in overall growth occurring in Gallatin County. Over the 20-year study period, the road would result in average annual losses of 174 jobs and $2.4 million in personal earnings. These change would cause a 0.5 percent decrease in county employment and 0.3 percent less personal income. The effects of job and income transfers to Madison County would be felt in the Big Sky community, and the Gallatin Gateway, and Bozeman areas.

Table S-2
Summary of Employment and Earnings Impacts of the Jack Creek Road "Minimum Road Design" for Selected Years 1994-2015

MADISON COUNTY

	Employment Impacts (Number of Jobs)					
	1994	1995	2000	2005	2010	2015
Road Construction	24	24				
Worker Relocation			114	128	142	156
Lodging in Ennis			2	5	6	6
Day-Trips from B.Sky			5	6	7	7
New Rec. Home			12	14	16	17
New Seasonal Residents			6	12	20	27
Cross Commerce			4	4	4	4
Drive-through Traf.			1	1	1	1
Total Employment	24	24	145	169	195	218

MADISON COUNTY

	Earnings Impacts (in millions of 1992 $)					
	1994	1995	2000	2005	2010	2015
Road Construction	$0.378	0.378				
Worker Relocation			1.712	1.920	2.128	2.338
Lodging in Ennis			0.035	0.070	0.078	0.086
Day-Trips from B.Sky			0.080	0.089	0.099	0.109
New Rec. Homes			0.208	0.232	0.258	0.283
New Seasonal Residents			0.527	1.123	1.929	2.520
Cross Commerce			0.063	0.062	0.061	0.058
Drive-through Traf.			0.011	0.012	0.012	0.013
Total Earnings	$0.378	0.378	2.634	3.508	4.566	5.407

GALLATIN COUNTY

	Employment Impacts (Number of Jobs)					
	1994	1995	2000	2005	2010	2015
Road Construction	34	34				
Worker Relocation			-131	-146	-162	-179
Day-Trips from B.Sky			-7	-8	-8	-10
Cross Commerce			-6	-6	-6	-6
Drive-through Traf.			-1	-1	-1	-1
Total Employment	34	34	-144	-161	-177	-195

GALLATIN COUNTY

	Earnings Impacts (in millions of 1992 $)					
	1994	1995	2000	2005	2010	2015
Road Construction	$0.615	0.615				
Worker Relocation			-1.957	-2.196	-2.434	-2.673
Day-Trips from B.Sky			-0.105	-0.120	-0.130	-0.143
Cross Commerce			-0.087	-0.087	-0.085	-0.085
Drive-through Traf.			-0.012	-0.013	-0.015	-0.016
Total Earnings	$0.615	0.615	-2.162	-2.416	-2.664	-2.916

SUMMARY REPORT 3
JACK CREEK ROAD BENEFIT-COST ANALYSIS

Introduction

The purpose of a benefit-cost analysis is to help decide whether a project is worth doing, specifically by providing information on whether the benefits of the project are greater than its costs. A benefit-cost analysis is typically needed for public projects because they are not generally designed to meet market tests and to be self-financing. Therefore it is sometimes the case that such projects may absorb public funds for long periods of time even though the funds spent on them might provide greater benefits if spent elsewhere.

This benefit-cost analysis for the proposed Jack Creek Road project focuses on the direct benefits and costs of the road. The direct benefits of the road are the benefits to those who use it. These benefits are measured by the "consumer surplus" associated with use of the road, and primarily by the value of time saved by having a shorter route. (Reduced vehicle operating and fuel costs are also estimated.)

The economic effects of the road on the community of Ennis are projected elsewhere in this report, and are not included in the benefit-cost analysis. An appendix to the Technical Report discusses this issue at length. Three reasons for not including job and income benefits in this analysis are:

> (1) Much of the economic activity resulting in Ennis would be activity transferred from other locales, especially the Bozeman area. A benefit accruing to Ennis would be offset by benefits lost to these other locales.
>
> (2) While income received for sales of goods and services to the project may be benefits to the seller, and while jobs on the construction project may be benefits to the workers, from an economic perspective they are part of the cost of the project. The payments for labor and for goods and services are payments to secure resources for the project that could be used elsewhere in the economy. Counting these payments as benefits understates the resource cost of the project, and more generally, leads to incorrect project selection.
>
> (3) While a more prosperous community is clearly a gain to society, it is by no means clear how to measure it. A counting of jobs or of increased community income would be a great overstatement of the benefit, as can be seen by asking how much the community might be willing to pay for the gains.

There are other benefits that may result from the construction of the road that might properly be included in a benefit-cost analysis, but were not estimated for this study. They should

nevertheless be weighed by decision-makers. These include benefits to hunters, which were not estimated because, as discussed in the Technical Report, it is not clear whether the road would increase or decrease overall hunter benefits. Benefits to sightseer road users were felt to be a small portion of total benefits and were not estimated for this study. External benefits of the road, such as the option it provides for faster emergency access to medical care or for fire suppression or public safety personnel, were not estimated for this study.

Similarly, the social costs of the road may not be the same as the private costs. For example, some of the labor on the project might be otherwise unemployed, so labor costs may overstate the opportunity costs of the project to society. An adjustment to labor costs is made in this study to account for this possibility. There may also be significant external, non-monetary costs connected with the Jack Creek Road, not included in this analysis, which should be evaluated in an Environmental Impact Statement and be considered by decision-makers. Prominent among these are impacts to grizzly habitat and to elk migration corridors. Others include potential congestion effects on recreational use of the Madison River associated with additional development in the Madison Valley, and potential peak weekend traffic congestion in Ennis.

Direct benefits of the Jack Creek Road

Direct benefits estimated for this report include the following:

(1) Reduced travel time and reduced vehicle operating cost associated with a shorter route for skiers from various locations in western Montana.

(2) Reduced commuting time and reduced vehicle operating costs for workers at Big Sky who may choose to live in Ennis instead of Bozeman or Belgrade or Gallatin Gateway.

(3) Shorter driving time and reduced vehicle operating cost for vacationers staying at Big Sky who visit Ennis and Madison County instead of Bozeman.

For each category, annual use of the road, and the benefits per person or per trip, were estimated. These were escalated to 1996, the assumed earliest date the road could be in place. The escalation was based on a forecast of future skier-days at Big Sky.

Costs of the road include construction costs, incurred over 2 construction seasons, and annual maintenance costs over the course of the study period. The labor portion of costs may overstate social costs to the extent jobs will be filled by otherwise unemployed labor. External costs, including environmental costs, may be significant. They are discussed, but are not quantified, in this study.

Benefits (and costs) were projected over a 30 year study period extending from 1996 to 2025. They were then discounted back to 1992, using a 3 percent real social discount rate. The effects of using alternate discount rates are presented in the Technical Report.

In addition to the presentation of Net Present Value of benefits less costs, the report also presents information of the payback period. Decision-makers may also want to consider this information in deciding to commit public funds to a project.

Estimated benefits and costs are presented below. All estimates are in 1992 dollars.

Skier travel time benefits

A gravity model was developed to allocate the estimated 45,560 Montana skier-days at Big Sky in 1989, as well as the Montana skier-days at 7 other ski areas, to different points of origin in Montana. This model predicts that of the 45,560 skier-days, 26,768 were from origins that would have a shorter travel time using the Jack Creek Road. The model also predicts an additional 2638 skier-days would be induced by the easier access. Travel time was valued at $10 per hour, and vehicle operating costs were assumed to be $0.29 per mile, with 3 skiers assumed per car.

Table S3

1989 Skier-day Allocation Benefits

Source	Amount
Consumer surplus: existing skier-days diverted to Jack Creek	$243,431
Consumer surplus: additional skier-days induced by new road	21,243
Total 1989 consumer surplus	264,674
Vehicle O&M savings	98,505
Total 1989 allocation benefits	363,179
Projected 1996 benefitS	449,154
1992 Present Value of 96-25 benefits	$10.77 million

Commuting Worker Benefits

Benefits received by Big Sky workers commuting from Ennis are estimated at $181,402 for 1991-92 levels of employment, or $203,680 for 1996, the first year of the project life. The 1992 present value of worker benefits over the 30 year study period is estimated at $4.88 million.

Winter tourist visits from Big Sky to Ennis

Out-of-state skiers staying at Big Sky, as well as Big Sky residents, will make use of the Jack Creek Road to visit Ennis, for shopping, dining or other reasons. These visits are assumed to be 1 percent of the ski-season residents at Big Sky, and for 1991 data are estimated to generate $87,229 in consumer surplus due to reduced driving time to Ennis compared to Bozeman. In addition, the reduced mileage would generate $34,549 in reduced operating costs. The 1992 present value of benefits over the 30 year project life would be $3.38 million, assuming a 3 percent real social discount rate.

Spring, summer and fall visits to Ennis

Day trip visits from convention attendees and Big Sky residents are arbitrarily assumed to be 1 percent of average spring, summer and fall populations at Big Sky, including convention visitors, vacationers, residents and resident workers. Benefits for 1991 would be $96,930 in the value of reduced travel time and $37,339 in reduced vehicle operating costs, for a total of $134,269. The 1992 present value of benefits, at a 3 percent discount rate over a 30 year study period, would be $3.73 million.

Total Benefits

The sum of the above estimated benefits for the project, over a 30 year project life, is $22.76 million (1992 Present Value). To this amount should be added the value of benefits for which no monetary estimates were made, such as those to hunters and sightseeing tourists; reduced property damage, injury and loss of life due to a possible reduction in motor vehicle accidents; and the value of improved access to Big Sky for emergency vehicles. However, the value of external costs, such as the impact of the road itself on habitats and migration routes and of increased legal and illegal hunter access on grizzly and elk populations, must also be considered. Such values should be subtracted from the benefits of the road, along with direct costs, in arriving at an estimate of the net present value of the road.

COSTS OF THE JACK CREEK ROAD PROJECT

Estimated costs of building the Jack Creek Road include engineering costs, right-of-way acquisition costs and construction costs. Once built the road must be maintained. Annual maintenance costs include the costs of snow-removal. Costs were estimated for this study for two levels of construction design. The high standard design is the base case for this study. It would permit average speeds of 50 mph.

Direct costs

1. Engineering, design and construction costs

The estimated cost of designing and building the Jack Creek Road to high standards is $21.5 million. Construction would take place over two construction seasons, in 1994 and 1995. All cost estimates are instantaneous costs in 1992 dollars.

Design and construction to the minimum standard is estimated to cost $17.0 million.

2. Maintenance and snow removal costs

Maintenance and snow removal costs on the high standard road are estimated to be $124,592. These costs would be $110,500 for the low standard road.

3. Adjustment for unemployed labor

Labor costs for the project may overstate the opportunity cost to society of building the road, if some of the labor would have been otherwise unemployed. The reason for this is that for those workers, the wage rate overstates their productivity that would be foregone by employing them on the road project. For this study an adjustment method was used that was developed by Robert Haveman and John Krutilla, that estimates the likelihood of using unemployed labor depending on the unemployment rate.

Adjusted construction cost estimates are $21.29 million for the high standard road and $16.83 million for the minimum standard. There was also a small adjustment in maintenance costs.

4. External costs

In addition to the direct costs of building and maintaining the road there may be additional costs imposed by the road. It is helpful to consider these external costs as additional resources that will be committed, along with the concrete and labor and machine time, by a decision to build the road.

Much of the external cost is borne by environmental resources. It is not possible here to do more than allude to them, but they will presumably be the subject of a full Environmental Impact Statement complying with the requirements of both state and federal laws (MEPA and NEPA). Environmental statutes permit, but do not require, that environmental impact information be placed in a benefit-cost framework. Because such a framework has been created through this study, it would be both relatively easy and highly informative to incorporate the results of an EIS into this analysis.

The major environmental external cost that has been suggested likely to result from construction of the Jack Creek Road is interference with wildlife migration corridors and loss of habitat.

The species at greatest risk is the Grizzly, and it has been suggested that the road would impact Grizzly populations in the Madison range. Elk populations may also be affected. If the construction of the road leads to significant additional second home or condominium development in the Madison Valley then additional species such as antelope may be impacted.

Net present value of the Jack Creek Road Project

At a 3 percent discount rate the net present value of benefits less costs are estimated to be $0.77 million for the high standard road.

Sensitivity and payback period

Benefits and costs were also estimated over a range of discount rates. The undiscounted value of benefits less costs over the 30 year study period is $14.77 million. A 2 percent discount rate yields an estimated $4.29 million. A discount rate of 6 percent results in a negative net present value of -$5.77 million.

Payback periods were also examined. The simple payback period of undiscounted benefits over costs is 20 years. That is, the cumulative sum of benefits less costs becomes positive in the year 2015, 20 years after the road is open to traffic (and 21 years after the first costs are incurred). With a 2 percent discount rate the payback period is 25 years (2020). With a 3 percent discount rate the payback is 29 years (2024). At 4.31 and 6 percent rates, the payback is beyond the study period.

Low standard construction alternative

At the request of members of the Jack Creek Road Task Force, this study included analysis of a lower design standard alternative. The minimum standard design is the lowest cost road that would be acceptable to the Montana Department of Transportation, and for which they would be willing to assume maintenance responsibility. It would permit a travel time between Ennis and Big Sky of 42 minutes. Consequently it provides consistently lower benefits than the high standard road.

The present value of estimated benefits for the low standard road are $7.34 million for skiers; $2.61 million and $2.88 million, respectively for day visits from Big Sky to Ennis in the ski season and the summer, respectively; and $3.00 million for worker benefits. Labor-adjusted construction and maintenance costs have a present value of $17.61 million. The net present value of the low standard alternative is negative with a 3 percent discount rate, equal to -$1.79 million.

TECHNICAL REPORTS

Page

1. JACK CREEK ROAD COST ESTIMATE....................................18
2. LOCAL ECONOMIC IMPACTS OF THE JACK CREEK ROAD............34
3. JACK CREEK ROAD BENEFIT COST ANALYSIS.....................84

Technical Report 1
JACK CREEK ROAD COST ESTIMATE

Table of Contents

A. DISCUSSION of PROJECT....................................18
B. ROADWAY STANDARDS...19
C. OVERVIEW of the CONCEPTUAL DESIGN..........................21
D. OPERATION and MAINTENANCE COSTS............................27
E. TRAVEL TIME ESTIMATES.....................................29
F. COST ESTIMATING RESULTS and CONCLUSIONS....................32
G. SUPPORTING DATA...32

List of Figures

1. Construction Cost Estimate Design Standards.................20
2. Right of Way Requirements...................................23
3. Conceptual Design - Hydrologic Calculations.................25
4. Drainage Pipes and Bridges..................................26
5. Annual Operation and Maintenance Cost Estimate..............28
6. Travel Time Estimate - Good Weather Conditions..............30
7. Travel Time Estimate - Winter Weather Conditions............31
8. Jack Creek Road, Construction Cost Estimate.................33

Technical Report 1
JACK CREEK ROAD COST ESTIMATE

A. DISCUSSION of PROJECT

This project addresses the economic impacts of developing a public roadway connection between Ennis, Montana and the Big Sky ski resort. A private roadway already connects these locations through the Jack Creek drainage basin. However it is not suitable for use by the public. As a result, this study has been prepared to estimate the costs required to improve the existing route to standards that are acceptable for public use.

The existing connection consists of about 13.3 miles of one-lane dirt logging road; 9.6 miles of two-lane county gravel road, 0.9 miles of two-lane hard surfaced county road, and about one mile of paved state highway. The total route length is about 24.8 miles, and has a good-weather travel time of slightly more than one hour. The upper 13.3 miles of the roadway lies entirely on private land and is closed to the public. The rest of the route is maintained for minimum public use, serving local land access and recreational attractions in the Jack Creek area.

Conceptual designs for the proposed roadway are based on typical Montana highway standards for mountainous areas. Since the exact roadway needs are not known at this time, two versions of the design are evaluated in this study. A "Minimum Design" is evaluated to indicate the lower end of expected costs, and a "Desirable Design" indicates the upper end of expected costs. Actual costs of a selected design are expected to lie somewhere between these two values.

Conceptual designs were developed for the route by using terrain data from USGS topographic maps, a video tape of the existing roadway, and point coordinate data for the existing roadway. Both the video tape and point coordinate data for the existing roadway were obtained by volunteers interested in the project, and provided to the consultant.

Using global positioning system (GPS) equipment, the volunteers were able to obtain three-dimensional coordinates (north, east, elevation) for the existing roadway as they drove and videotaped it. The consultant then used their data along with contour information from USGS topographic maps to generate an approximate computer model of the terrain along the intended route.

New roadway designs were then developed to estimate how an acceptable route could be built through the corridor. Quantities were estimated for earthwork, paving materials, drainage facilities, and other related components of the proposed construction. Costs were estimated by applying unit prices to each of the identified quantities. Unit price data were obtained from Montana Department of Transportation Bid Tabulations of roadway cost data for 1991.

Annual maintenance and operation costs were estimated using average lane-mile maintenance costs for similar roadways, obtained from the Montana Department of Transportation, Maintenance Bureau.

Finally, travel time was estimated for each design alternate in good weather, and under winter weather conditions.

B. ROADWAY STANDARDS

Montana roadway designs are standardized as much as possible to ensure that the public enjoys reasonable safety and convenience while travelling Montana's highways. If this route is developed between Big Sky and Ennis, it is assumed that it will need to comply with these standards. In addition, since the route crosses fairly high-elevation, mountainous terrain and would need to stay in service throughout the winter, maintenance considerations also influence minimum design standards.

The roadway designs evaluated in this study are based on 40 mile-per-hour and 50 mile-per-hour design standards for Montana primary highways. Both designs call for two paved 12-foot-wide traffic lanes, and paved shoulders. Shoulders are eight-feet-wide for the desirable design, reflecting the perceived need to accommodate stopped traffic for emergencies and other purposes. The minimum design calls for three-foot-wide shoulders, reflecting a design standard that was used for Montana route P-64, which provides access to Big Sky from highway 191 from the east.

Both designs assume an 18" depth of paving materials. Both call for 6:1 sloped tapers on the outside edges of the paving materials, and an additional six foot width of 6:1 slope on the subgrade. This results in about 16 feet of 6:1 sloped area outside the paved shoulders to the "hinge point". From the hinge point, both designs begin fill slopes in areas where the new roadway lies above the existing ground. Fill slopes vary from 6:1 to 2:1 (horizontal :vertical) depending on the height of fill.

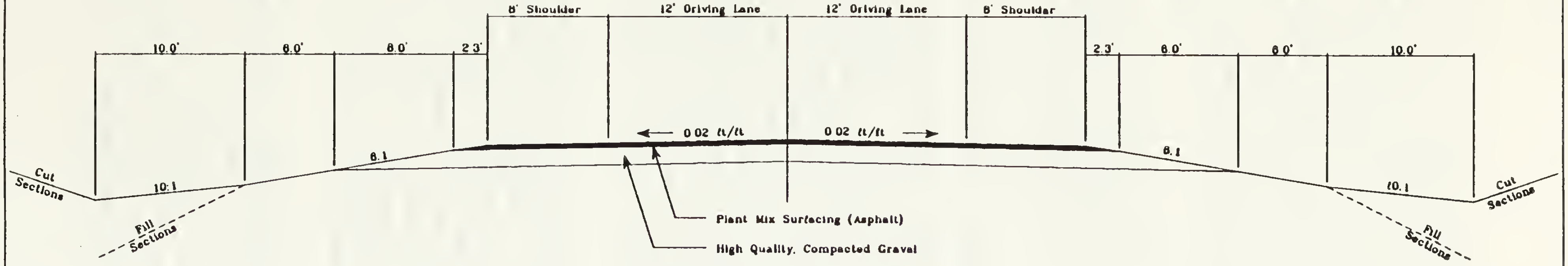
In areas where the new roadway lies below the existing ground, cut slopes are used to connect the new roadway to the natural terrain. These slopes vary from 5:1 to 1.5:1, based on the depth of cut. For the minimum design, cut slopes begin at the same hinge point as the fill slopes. For the desirable design, a ten-foot-wide, flat bottom ditch is inserted outside the 6:1 inslopes, moving the hinge point out ten feet on each side. This provides better drainage, additional obstacle-free recovery area for out-of-control vehicles, storage for fallen rock, and additional snow storage area.

The features just described are shown in Figure 1.

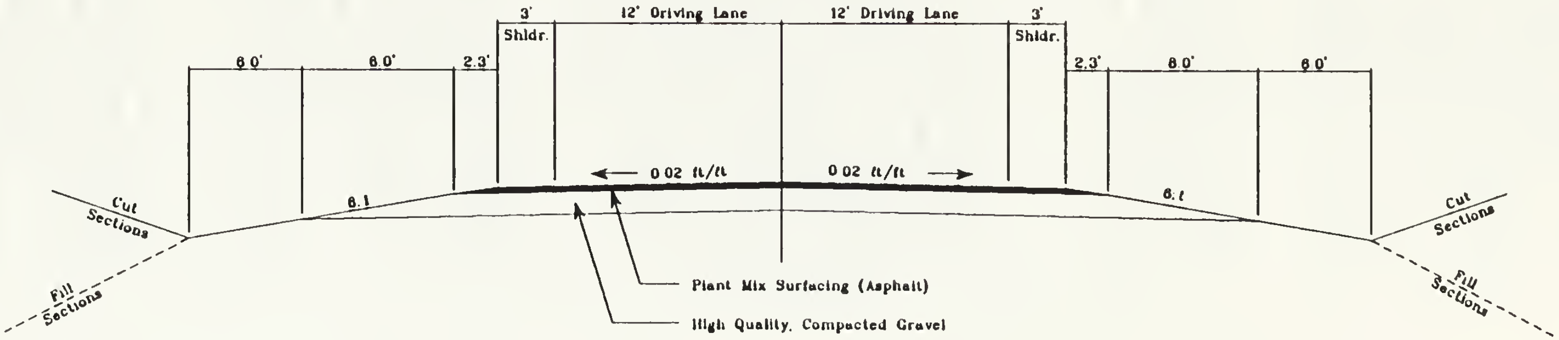
FIGURE 1

JACK CREEK ROAD
Construction Cost Estimate
DESIGN STANDARDS

Desirable Design
(50 mph)



Minimum Design
(40 mph)



The design speed of a roadway (40 mph and 50 mph here) defines how sharp curves can be (degree of curvature) and how steep the roadway can climb or descend (gradient). 50 mph standards require that horizontal degree of curvature not exceed 7°30' (seven degrees and thirty minutes, or seven and one-half degrees per one hundred feet length), and the gradient not exceed 7%. 40 mph standards require that horizontal degree of curvature not exceed 12°15', and the gradient not exceed 10%. Montana standards also call for spiral transitions into and out of many horizontal curves based on their degree of curvature. Generally this results in 150' or 200' transitions at each end of horizontal curves.

Design standards also define other roadway characteristics that have lesser impacts on construction costs. Although they are important for safety and other considerations, they are not strictly followed in this analysis, since they are not crucial to cost estimating at this stage.

C. OVERVIEW of the CONCEPTUAL DESIGN

Once the computerized terrain model was developed a horizontal alignment was designed. The alignment was designed to meet or exceed 50 mph standards, generally follow the existing roadway, and match the surrounding terrain as much as possible. Following development of the horizontal alignment, a vertical alignment was designed to meet or exceed 50 mph standards. The combination was then checked against the natural terrain and adjusted until they reasonably matched the existing groundline. A "template" for the road design, showing widths, ditches, and connecting cut or fill slopes was then attached to the alignments. The design and computerized terrain model were then analyzed using a computer program to determine the approximate volume of required earthwork.

The selected horizontal and vertical alignments are designed to the limits of the 50 mph design standards in some areas, and to higher design speeds in others. In general, the design represents an aggressive attempt to match roadway and terrain. However, efforts at the final design stage should be able to improve the match between roadway and terrain, resulting in slightly lower earthwork volumes if desired. Since the horizontal and vertical alignments are based on terrain data of limited accuracy, they are assumed to be generally applicable to both the 50 mph and the 40 mph designs.

As a result, earthwork volume calculations were performed using two different templates (indicating different widths and ditch designs) attached to the same alignments. The results were then interpreted to reflect how the final design might actually be accomplished. 50 mph earthwork cut and fill volumes were averaged to reflect a possible desire that the earthwork design be balanced to eliminate the need (and cost) of wasting or borrowing material. 40 mph earthwork volumes were already fairly well balanced, so no averaging was needed. The 40 mph volumes

were decreased slightly to reflect a possible desire to increase curvature and gradient to save money.

This process resulted in an approximation of a design that would safely accommodate 50 mph travel in good weather. Its length is about 21 miles, consisting of about one mile of existing paved highways, about seven miles of new highway over existing county roads, and about 13 miles of new construction.

The 40 mph design is assumed to be slightly longer due to the increased curvature that would be accepted to keep earthwork costs down. This design is assumed to be 22.5 miles long, consisting of the same one mile of existing paved roads, about eight miles of new highway constructed on existing county roads, and about 13.5 miles of new construction. Although this roadway design was not used for earthwork calculations, it was used to calculate other quantities.

A paving section was defined based on typical highway construction materials and thicknesses. It was assumed to consist of four inches of asphalt material over 14 inches of high quality gravel. Material and installation quantities were calculated for each design, based on the width and length of each.

After alignment, grade, and earthwork estimates were developed, other construction costs were estimated. Roadbed compaction costs are closely related to the estimated amount of earthwork, so they were calculated directly from these estimates. Related costs such as clearing and grubbing (removing vegetation), storing and replacing topsoil, seeding, and fertilizing were estimated based on the approximate widths of disturbed area for each design corridor.
Right-of-way acreages were estimated based on the same information. Existing right of way was assumed to average 60 feet (30' each side of centerline) for about the first 8 miles, then 30 feet for about two more miles to the end of the public roadway. No existing right of way was assumed through the last 13-14 miles of private land. The right-of-way acreage estimate is shown in Figure 2.

FIGURE 2

JACK CREEK ROAD
Construction Cost Estimate
Right of Way Requirements

STATIONING		50 MPH Design				40 MPH Design			
From	To	Distance (Feet)	Existing R/W Width (Feet)	New R/W Width (Feet)	New R/W Area (Acres)	Distance (Feet)	Existing R/W Width (Feet)	New R/W Width (Feet)	New R/W Area (Acres)
0	10+00	1000	60	160	2.30	1000	60	60	0.00
10+00	30+00	2000	0	160	7.35	2000	60	60	0.00
30+00	70+00	4000	60	160	9.18	4000	60	60	0.00
70+00	90+00	2000	0	160	7.35	2550	60	60	0.00
90+00	95+00	500	60	160	1.15	500	60	60	0.00
95+00	115+00	2000	0	160	7.35	2475	60	60	0.00
115+00	170+00	5500	30	160	16.41	5500	30	160	16.41
170+00	190+00	2000	0	160	7.35	2000	60	60	0.00
190+00	340+00	15000	60	160	34.44	15000	60	60	0.00
340+00	380+00	4000	0	160	14.69	5100	60	60	0.00
380+00	495+00	11500	30	200	44.88	12472	30	200	48.67
495+00	675+00	18000	0	300	123.97	19521	0	250	112.04
675+00	705+00	3000	0	250	17.22	3254	0	200	14.94
705+00	810+00	10500	0	300	72.31	11387	0	250	65.35
810+00	975+00	16500	0	250	94.70	17894	0	200	82.16
975+00	1035+00	6000	0	300	41.32	6507	0	250	37.35
1035+00	1056+76	2176	0	200	9.99	2360	0	160	8.67
TOTALS		**105676**			**511.96**	**113520**			**385.59**

The entire Jack Creek drainage basin was delineated and measured to estimate the size of areas contributing to runoff. The method described in U.S. Geological Survey "Water-Resources Investigations Report 86-4027" was then used to estimate flow rates for runoff at each location where an identifiable waterway crossed the proposed roadway. Runoff volumes were based on a 50 year recurrence interval storm, meaning that they should occur only once per 50 years on average. The calculations are summarized in Figure 3.

Runoff flow rates were then used to estimate the size of drainage facilities required for each crossing. The analysis indicated a need for culverts ranging from 18" diameter to 84" diameter. Two crossings near the mouth of the Jack Creek canyon were deemed too demanding for culvert crossings because of the high flow rates coupled with low allowable headwater depths. Each of these two crossings was estimated to require a 40 foot long bridge. Drainage pipe and bridge quantity estimates are shown in Figure 4.

Since some channel modifications are expected to be necessary, quantities were estimated for erosion control construction fabric and riprap materials. Although these quantities are highly dependent on the final design, they were estimated anyway for this analysis, based on the apparent needs of the conceptual design.

A few other miscellaneous costs were identified for items such as guardrail, signing, and pavement markings. These were estimated using broad assumptions of their need on the roadway.

JACK CREEK ROAD CONCEPTUAL DESIGN
HYDROLOGIC CALCULATIONS
April 11, 1992

Basin No.	Basin Name	Size (Acres)	Size (Square Miles)	Area Above 6000'	Geogr. Factor	Rate of Runoff, cubic feet/second, (cfs) Q50%	Q20%	Q10%	Q4%	Q2% (design)	Q1% (base)
USGS, Jack Creek Gaging Sta. - RECORD			**51.5**			**327**	**422**	**480**	**547**	**595**	**641**
USGS, Jack Creek Gaging Sta. - CALCULATED			51.5			163	284	404	531	663	798
1	Alluvial Fan North of Cedar Creek	11300	17.7	20%	0.9	50	126	222	377	550	769
2		400	0.6	0%	0.9	2	10	23	56	105	181
3		30	0.1	30%	0.9	0	2	4	7	11	17
4		210	0.3	70%	0.9	1	4	7	11	16	21
5		215	0.3	80%	0.9	1	4	6	10	14	19
6		190	0.3	80%	0.9	1	4	6	10	14	19
7		320	0.5	90%	0.9	2	6	9	14	19	25
8		350	0.5	80%	0.9	2	6	9	15	21	27
9		550	0.9	80%	0.9	4	9	15	23	31	40
10	Mill Creek	4050	6.3	95%	0.9	23	44	65	88	113	137
11		27040	42.3	99%	0.9	129	205	283	353	424	493
12		350	0.5	100%	0.9	2	6	9	13	18	23
13	West Hammond Creek	1210	1.9	100%	0.9	8	17	25	35	47	58
14		375	0.6	100%	0.9	3	7	10	15	21	26
15	East Hammond Creek	1860	2.9	100%	0.9	12	23	35	48	63	77
16		310	0.5	100%	0.9	2	6	9	13	18	23
17	Wickiup Creek	685	1.1	100%	0.9	5	11	16	24	32	39
18		145	0.2	100%	0.9	1	3	4	7	9	12
19		225	0.4	100%	0.9	2	5	7	11	15	20
20		520	0.8	100%	0.9	4	8	13	19	25	32
21		610	1.0	100%	0.9	4	10	15	22	30	37
22		120	0.2	100%	0.9	1	3	4	7	9	12
23		140	0.2	100%	0.9	1	3	4	7	9	12
24		370	0.6	100%	0.9	3	7	10	15	21	26
25		450	0.7	100%	0.9	3	7	11	17	23	29
26		525	0.8	100%	0.9	4	8	13	19	25	32
27	Moonlight Creek	360	0.6	100%	0.9	3	7	10	15	21	26
28		80	0.1	100%	0.9	1	2	3	4	6	8
29		80	0.1	100%	0.9	1	2	3	4	6	8
30		675	1.1	100%	0.9	5	11	16	24	32	39
31	(East of Divide)	200	0.3	100%	0.9	2	4	6	9	13	16
32	(East of Divide)	260	0.4	100%	0.9	2	5	7	11	15	20

NOTES:

Jack Creek Gaging Station (USGS #06040300) includes flow from Basins #3 - #30
Basin #1 includes flow from Basin #2
Basin #11 includes flow from Basins #12 - #30

JACK CREEK ROAD
Construction Cost Estimate
Drainage Pipes and Bridges

Station	Basin No.	Name of Drainage	Length, feet, (based on 40' paved top)						Bridge (sq. ft.)
			18"	24"	36"	48"	60"	84"	
20+00		Cedar Creek			100				
65+00		Irrigation		80					
100+00	1	Alluvial Fan					100		
120+00	1	Alluvial Fan					100		
300+00		Irrigation		80					
400+00		Jack Creek							1600
425+00		Jack Creek							1600
460+00	8			100					
485+00	9				100				
500+00	11	Jack Creek						200	
530+00				100					
581+00	12			100					
595+00	13	West Hammond Cr.			150				
615+00	14			200					
652+00	15	East Hammond Cr.			200				
662+00				100					
671+00	16			150					
715+00	17	Wickiup Creek			200				
746+00	19			200					
752+00	20				200				
773+00				150					
787+00	21				200				
829+00	22			100					
850+00	23			150					
864+00	24			150					
877+00	25				100				
893+00	26				200				
896+00	26			100					
910+00	27	Moonlight Creek		100					
924+00	28			100					
928+00	29			150					
950+00				100					
968+00	30				100				
984+00				150					
1033+00	31			100					
		80 Approach Pipes	6000	200				200	
		TOTALS	**6000**	**2660**	**1550**	**0**	**200**	**400**	**3200**

D. OPERATION and MAINTENANCE COSTS

The Montana Department of Transportation Maintenance Bureau maintains a comprehensive log of operation and maintenance costs for all roadways that they maintain. Costs included in their statistics include regular inspections, snow plowing, sanding, and repairing damages to the roadway and related facilities. Their latest 3-year statewide average for primary highways indicates an average annual cost of $406 per year for each lane mile. (One mile of two lane highway equals two lane miles.) Their database also provides statistics on roadway segments, such as route P-64 which provides access to Big Sky from the east. This route's latest 3-year average annual maintenance cost is $1,283 per year for each lane mile.

Operation and maintenance costs were not included for the one mile of existing roadway on this route that will continue to be used, since these costs are already being incurred. For the 7-8 miles of new roadway from Ennis to the mouth of the Jack Creek canyon, the statewide average values were applied to the new roadway, since it is likely to be similar to the state's "average" roadway. Maintenance costs for the remaining length of each design are assumed to be similar to route P-64.

A component of roadway maintenance and operation that is not included in the state's figures is the long-term cost of maintaining the pavement. In general, an asphalt pavement is designed to last for 20 years. In reality however, periodic maintenance is required to keep it in a serviceable condition, and extend its useful life indefinitely. Accordingly, a pavement management plan was estimated for this roadway. It calls for resealing the roadway surface at 7 years, providing a 0.3' overlay at 14 years, and resealing again at 20 years. This sequence is assumed to continue indefinitely.

MDT maintenance and operation costs and the proposed pavement management costs were calculated for each design alternate. The two costs were then combined into total anticipated maintenance and operation costs, as shown in Figure 5.

FIGURE 5

JACK CREEK ROAD
Annual Operation and Maintenance Cost Estimate

ANNUAL MAINTENANCE COSTS	Desirable Design (50 mph, 20 miles new paved roadway)					Minimum Design (40 mph, 21.5 miles new paved roadway)				
	Material (25%)	Equipment (15%)	Labor (50%)	Profit (10%)	TOTAL COST	Material (25%)	Equipment (15%)	Labor (50%)	Profit (10%)	TOTAL COST
Inspect/Repair/Plow & Sand	$9,673	$5,803	$19,346	$3,869	$38,691	$10,416	$6,249	$20,832	$4,166	$41,663
Pavement Maintenance	$39,984	$11,995	$19,992	$7,997	$79,968	$31,790	$9,537	$15,895	$6,358	$63,580
Subtotal	$49,657	$17,798	$39,338	$11,866	$118,659	$42,206	$15,786	$36,727	$10,524	$105,243
5% Cont. & Engr.	$2,483	$890	$1,967	$593	$5,933	$2,110	$789	$1,836	$526	$5,262
TOTAL	$52,140	$18,688	$41,305	$12,459	$124,592	$44,316	$16,575	$38,563	$11,050	$110,505

E. TRAVEL TIME ESTIMATES

Travel time was estimated for the existing route and each of the design alternatives. The good weather estimate for the existing route is based on the observed travel time required to videotape the roadway. The good weather travel time estimates for the other two routes are based on the design speed and length of each.

In all cases the travel speed for the one mile segment of existing highway is assumed to be 55 mph. The segment from highway 87 to the mouth of the Jack Creek canyon is assumed to be 30 mph for the existing condition, as observed, and the design speed (40 mph/ 50 mph) for each of the design alternates. The segment from the mouth of the Jack Creek canyon to the end of existing pavement at Big Sky is assumed to be 20 mph for the existing condition, and the design speed for each of the design alternates.

Winter weather driving condition travel time estimates still assume a 55 mph travel speed for the existing highway segments. The existing roadway travel time estimate assumes 20 mph to Jack Creek, and then 5 mph to Big Sky. This reflects a lower level of maintenance on the county roads, and virtually no maintenance on the private logging road. In fact, this route probably is not passable in most winter months. Travel speeds to Jack Creek on each of the alternates is assumed to be at their design speeds. Travel speeds from Jack Creek to Big Sky are assumed to be slightly lower for both design alternates in winter weather.

Travel time estimates, including route lengths, and assumed travel speeds are shown in Figures 6 and 7.

FIGURE 6

JACK CREEK ROAD CONCEPTUAL DESIGN
TRAVEL TIME ESTIMATE
Good Weather Conditions

	Existing Road (Unpaved)	Minimum Design (40 mph)	Desirable Design (50 mph)
ROUTE LENGTHS			
Exist. Pvmnt., Ennis to Big Sky	5280 ft.	5280 ft.	5280 ft.
Length of Alternate	125453 ft.	113520 ft.	105676 ft.
Total Length, Ennis to Big Sky	**130733 ft.**	**118800 ft.**	**110956 ft.**
	24.8 mi.	**22.5 mi.**	**21.0 mi.**
TRAVEL TIMES			
Distance - Existing Pvmnt.	1.0 mi.	1.0 mi.	1.0 mi.
Travel Speed - Existing Pvmnt.	55 mph	55 mph	55 mph
Travel Time - Existing Pvmnt.	00:01:05 hms	00:01:05 hms	00:01:05 hms
Distance to Jack Cr.	7.7 mi.	7.7 mi.	7.2 mi.
Travel Speed to Jack Cr.	30 mph	40 mph	50 mph
Travel Time to Jack Cr.	00:15:24 hms	00:11:33 hms	00:08:38 hms
Distance Above Jack Cr.	16.1 mi.	13.8 mi.	12.8 mi.
Travel Speed Above Jack. Cr.	20 mph	40 mph	50 mph
Travel Time Above Jack Cr.	00:48:18 hms	00:20:42 hms	00:15:22 hms
Total Travel Time	**01:04:47 hms**	**00:33:20 hms**	**00:25:05 hms**
Average Travel Speed	**23 mph**	**40 mph**	**50 mph**

NOTE:
All travel times are expressed in HOURS:MINUTES:SECONDS

FIGURE 7

JACK CREEK ROAD CONCEPTUAL DESIGN
TRAVEL TIME ESTIMATE
Winter Weather Conditions

	Existing Road (Unpaved)	Minimum Design (40 mph)	Desirable Design (50 mph)
ROUTE LENGTHS			
Exist. Pvmnt., Ennis to Big Sky	5280 ft.	5280 ft.	5280 ft.
Length of Alternate	125453 ft.	113520 ft.	105676 ft.
Total Length, Ennis to Big Sky	**130733 ft.**	**118800 ft.**	**110956 ft.**
	24.8 mi.	**22.5 mi.**	**21.0 mi.**
TRAVEL TIMES			
Distance - Existing Pvmnt.	1.0 mi.	1.0 mi.	1.0 mi.
Travel Speed - Existing Pvmnt.	55 mph	55 mph	55 mph
Travel Time - Existing Pvmnt.	00:01:05 hms	00:01:05 hms	00:01:05 hms
Distance to Jack Cr.	7.7 mi.	7.7 mi.	7.2 mi.
Travel Speed to Jack Cr.	20 mph	40 mph	50 mph
Travel Time to Jack Cr.	00:23:06 hms	00:11:33 hms	00:08:38 hms
Distance Above Jack Cr.	16.1 mi.	13.8 mi.	12.8 mi.
Travel Speed Above Jack. Cr.	5 mph	35 mph	45 mph
Travel Time Above Jack Cr.	03:13:12 hms	00:23:39 hms	00:17:04 hms
Total Travel Time	**03:37:23 hms**	**00:36:18 hms**	**00:26:48 hms**
Average Travel Speed	**7 mph**	**37 mph**	**47 mph**

NOTE:
All travel times are expressed in HOURS:MINUTES:SECONDS

F. COST ESTIMATING RESULTS and CONCLUSIONS

The conceptual design process yielded approximate cost estimates to build the Jack Creek road to two different standards. The "Minimum Design" alternate represents the minimum roadway standards that could be accepted if the roadway is to serve any significant amount of public traffic. In addition, this alternate represents the minimum roadway that could reasonably be expected to remain open throughout winter months.

At the upper limit of this analysis is the "Desirable Design". This alternate represents State of Montana design standards that are most likely applicable to this type of roadway. This is not necessarily the top-of-the-line design, but it is a roadway that should be generally acceptable to any reviewing agency.

This cost analysis focuses on the major cost items associated with the roadway construction. Some cost items, such as those for paving materials, are fairly well known. Quantities such as earthwork are approximated, but could vary significantly based on soil conditions in the field, and the accuracy of the terrain model. Numerous minor cost items are not as well known, since they are highly dependent on the final design.

Item by item cost estimates are assembled and tabulated in Figure 8. The total amounts shown include additional 10% contingencies for unanticipated costs. They each also include an additional 15% for engineering costs associated with environmental analysis, design, and construction. All estimates are based on current prices, without adjustments for future inflation. The 10% contingencies should not be viewed as a guarantee of the range of costs in this conceptual design, but rather as a general indication of the variability of costs in a final design.

Figure 8 indicates that the minimum cost that could reasonably be expected to construct this roadway is about seventeen million dollars. The figure also indicates that twenty one and one-half million dollars would construct a roadway that is more in line with current standards.

Total costs presented in Figure 8 are also broken down into four general categories - materials, equipment, labor, and profit. These figures provide some additional insight as to where the costs are going. The splits between categories are based on very general trends, as indicated by conversations with a couple of Montana contractors.

G. SUPPORTING DATA

Calculations, maps, cross sections, and design notes supporting the conceptual designs in this report are available for reference.

JACK CREEK ROAD
Construction Cost Estimate
April 11, 1992

			Desirable Design (50 mph, 20 miles construction)						Minimum Design (40 mph, 21.5 miles construction)					
CONSTRUCTION COSTS	Unit	Unit Cost	Design Quantity	Material	Equipment	Labor	Profit	TOTAL COST	Design Quantity	Material	Equipment	Labor	Profit	TOTAL COST
Right-of-Way	Acre	$400.00	512					$204,800	383					$153,200
Clearing and Grubbing	Acre	$1,000.00	120	$30,000	$48,000	$30,000	$12,000	$120,000	112	$28,000	$44,800	$28,000	$11,200	$112,000
Excavation	C.Y.	$1.75	5500000	$2,406,250	$3,850,000	$2,406,250	$962,500	$9,625,000	4000000	$1,750,000	$2,800,000	$1,750,000	$700,000	$7,000,000
Topsoil - Salv. & Place	C.Y.	$1.40	128000	$44,800	$71,680	$44,800	$17,920	$179,200	100000	$35,000	$56,000	$35,000	$14,000	$140,000
Roadbed Compaction	C.Y.	$0.25	5200000	$325,000	$520,000	$325,000	$130,000	$1,300,000	4100000	$256,250	$410,000	$256,250	$102,500	$1,025,000
Crushed Gravel	Ton	$6.00	444579	$666,869	$1,066,989	$666,869	$266,747	$2,667,474	386649	$579,974	$927,957	$579,974	$231,989	$2,319,894
Plant Mix	Ton	$11.00	106310	$584,705	$175,411	$292,353	$116,941	$1,169,410	87524	$481,382	$144,415	$240,691	$96,276	$962,764
Plant Mix Oil	Ton	$110.00	6383	$351,065	$105,319	$175,533	$70,213	$702,130	5256	$289,080	$86,724	$144,540	$57,816	$578,160
Prime Oil	Ton	$115.00	666	$38,295	$11,488	$19,148	$7,659	$76,590	556	$31,970	$9,591	$15,985	$6,394	$63,940
Tack Oil	Gal.	$0.55	26208	$7,207	$2,162	$3,604	$1,441	$14,414	21796	$5,994	$1,798	$2,997	$1,199	$11,988
Seal Oil	Ton	$150.00	803	$60,188	$18,055	$30,094	$12,038	$120,375	647	$48,525	$14,557	$24,263	$9,705	$97,050
18" Drain	L.F.	$30.00	6000	$90,000	$27,000	$45,000	$18,000	$180,000	6000	$90,000	$27,000	$45,000	$18,000	$180,000
24" Drain	L.F.	$35.00	2660	$46,550	$13,965	$23,275	$9,310	$93,100	2440	$42,700	$12,810	$21,350	$8,540	$85,400
36" Drain	L.F.	$45.00	1550	$34,875	$10,462	$17,438	$6,975	$69,750	1450	$32,625	$9,787	$16,313	$6,525	$65,250
60" Drain	L.F.	$75.00	200	$7,500	$2,250	$3,750	$1,500	$15,000	180	$6,750	$2,025	$3,375	$1,350	$13,500
84" Drain	L.F.	$155.00	200	$15,500	$4,650	$7,750	$3,100	$31,000	180	$13,950	$4,185	$6,975	$2,790	$27,900
Riprap	C.Y.	$30.00	5000	$75,000	$22,500	$37,500	$15,000	$150,000	5000	$75,000	$22,500	$37,500	$15,000	$150,000
Constr. Fabric	S.Y.	$0.75	7000	$2,625	$787	$1,313	$525	$5,250	7000	$2,625	$787	$1,313	$525	$5,250
Bridges	S.F.	$60.00	3200	$96,000	$28,800	$48,000	$19,200	$192,000	3200	$96,000	$28,800	$48,000	$19,200	$192,000
Guardrail	L.F.	$8.00	20000	$80,000	$24,000	$40,000	$16,000	$160,000	20000	$80,000	$24,000	$40,000	$16,000	$160,000
Signing/Pvmnt. Markings	Mile	$7,000.00	20.0	$70,000	$21,000	$35,000	$14,000	$140,000	21.5	$75,250	$22,575	$37,625	$15,050	$150,500
Fencing	Rod	$15.00	1280	$9,600	$2,880	$4,800	$1,920	$19,200	9500	$71,250	$21,375	$35,625	$14,250	$142,500
Seed & Fertilizer	Acre	$150.00	240	$18,000	$5,400	$9,000	$3,600	$36,000	225	$16,875	$5,062	$8,438	$3,375	$33,750
		Subtotal		$5,060,029	$6,032,798	$4,266,477	$1,706,589	$17,270,693		$4,109,200	$4,676,748	$3,379,214	$1,351,684	$13,670,046
		15% Contingencies		$759,004	$904,920	$639,972	$255,988	$2,559,884		$616,380	$701,512	$506,882	$202,753	$2,027,527
		10% Engineering				$1,706,589		$1,706,589				$1,351,685		$1,351,685
		TOTAL		$5,819,033	$6,937,718	$6,613,038	$1,962,577	$21,537,166		$4,725,580	$5,378,260	$5,237,781	$1,554,437	$17,049,258

NOTE: Right of way costs are not included in calculations for contingencies or engineering.

TECHNICAL REPORT 2
THE ECONOMIC IMPACTS OF THE JACK CREEK ROAD

Table of Contents

A. BASELINE CHARACTERISTICS....................................36
1. Population and Housing in Madison County and the Madison Valley....................................36
2. Madison County Economic Characteristics....................41
3. Big Sky Population and Economic Characteristics............48

B. ECONOMIC IMPACTS OF THE JACK CREEK ROAD...................52
SHORT-TERM IMPACTS
1. Impacts of Road Construction..............................53
LONG-TERM IMPACTS
2. Big Sky Worker Relocation.................................58
3. Skier Lodging in Ennis....................................61
4. Day Trips to Madison County...............................64
5. Recreation Home Development...............................69
6. Cross Commerce from Big Sky to Ennis......................72
7. Increased Drive-through Traffic in Madison County.........75
8. Population Impacts..77
9. Public Service Impacts....................................78
10. References...80

List of Tables

A. BASELINE CHARACTERISTICS

A-1, Historic Population Trends.............................36
A-2, Thirty-year Population Trends by Census Division and Incorporated Place.................................37
A-3, Age Profile Montana, Madison County, Madison Valley.....38
A-4, Income Profile Montana, Madison County, Madison Valley..38
A-5, Mean Households Income Comparisons by Income Type.......39
A-6, Madison Valley Housing Characteristics.................40
A-7, Population Projections Madison County..................41
A-8, Full- and Part-time Employment by Economic Sector.......42
A-9, Monthly Variation in Labor Force, Employment, and Unemployment..43
A-10, Quarterly Employment in Selected Economic Sectors 43
A-11, Components of Total Personal Income....................44
A-12, Percent of Total Personal Income by Income Category.... 45
A-13, Earnings Income by Economic Sector.....................46
A-14, Average Monthly Employment in Big Sky, Montana..........49
A-15, Average Quarterly Employment and Earnings in Big Sky, Montana..50

List of Tables (Continued)

B. ECONOMIC IMPACTS OF THE JACK CREEK ROAD

B-1, Predicted Construction Work Force Origination...........54
B-2, Estimated Expenditures for Selected Construction Materials and Supplies..................................55
B-3, Heavy Eqipment Expenditures............................55
B-4, Employment and Earnings Impacts of Project Construction.57
B-5, Comparison of Winter Travel Times......................58
B-6, Simulation of Effects of Jack Creek Road on the Place of Residence of 1991 Big Sky Workers..................59
B-7, Estimated Average Annual Employment and County of Residence..59
B-8, Economic Impacts of Worker Relocation in Madison County..60
B-9, Economic Impacts of Worker Relocation to Gallatin Co....61
B-10, Ennis Motels and Motel Rooms for Rent During Summer and Winter..62
B-11, Estimated Additional Motel Room Occupancy During Ski Season..63
B-12, Economic Impacts of Motel Use by Big Sky Skiers In Madison County...64
B-13, Average Daily Expenditures per Group for Highway Travelers by Season and Type of Expenditure............65
B-14, Estimated Annual Day-Trips from Big Sky to Ennis........66
B-15, Economic Impacts of Big Sky Resident and Visitor Expenditures in Madison County.........................67
B-16, Economic Impacts of Lost Resident and Visitor Expenditures in Gallatin County.........................68
B-17, Additional Home Construction in the Madison Valley......70
B-18, Economic Impacts of Additional Home Construction In Madison County...70
B-19, Additional Population Growth in the Madison Valley..... 71
B-20, Economic Impacts of Expenditures by Recreation Home Occupants...72
B-21, Economic Impacts of Expenditures by Permanent Big Sky Residents in Madison County...............................73
B-22, Economic Impacts of Reallocation of Expenditures of Permanent Big Sky Residents in Gallatin County.........74
B-23, Estimated Vehicle Trips Diverted from U.S. 191 to U.S Highway 287... 75
B-24, Economic Impacts of Drive Through Travelers In Madison County... 76
B-25, Economic Impacts of the Loss of Drive-through Travelers In Gallatin County.......................................77
B-26, Population Impacts of the Jack Creek Road on Ennis and the Madison Valley...78

TECHNICAL REPORT 2
LOCAL ECONOMIC IMPACTS OF THE JACK CREEK ROAD

A. BASELINE CHARACTERISTICS

1. Population and Housing in Madison County and the Madison Valley

a. Overview of Population Trends:

Madison County is one of the few rural counties in Montana which is increasing in population. Since 1970, the population of Madison County increased about 1,000 people, an increase of 19 percent.

Table A-1
Historic Population Trends
Madison County Montana
1940-1990

Year	Population
1940	7,294
1950	5,998
1960	5,211
1970	5,014
1980	5,448
1990	5,989

Source: U.S. Department of Commerce, Bureau of the Census, U.S. Census of Population: 1940-1990. Washington D.C. 1992.

b. Distribution of Population Growth:

The population of Madison County is distributed among five census divisions. Most of the county's recent population growth has been in the Madison Valley-Ennis area. The Madison Valley began to experience population increases in the 1960s. The Sheridan area is the only other part of Madison County experiencing population growth.

Much of the population growth in the Madison Valley has resulted from in-migration. This is illustrated by 1990 census data. Whereas 60 percent of the population of Montana is native to the state, only 47 percent of Madison Valley residents are native Montanans. Twenty-three percent of Montana residents resided in a different county in 1985 compared to 31 percent of the residents of the Madison Valley. Twelve percent of Montana's residents lived in another state or country in 1985 compared to 18 percent of persons living in the Madison Valley (U.S. Department of Commerce, Bureau of the Census, 1992).

Table A-2
Thirty-year Population Trends by Census Division and Incorporated Place
Madison County
1960-1990

CENSUS UNIT/YEAR	1960	1970	1980	1990	30-Year Change
Madison County	5,211	5,014	5,448	5,989	+778
Harrison Division	921	800	762	828	-93
No incorporated places					
Madison Valley Division	1,078	1,179	1,466	2,018	+940
Town of Ennis	525	501	660	773	+248
Sheridan Division	1,330	1,337	1,525	1,524	+194
Town of Sheridan	539	636	646	652	+113
Twin Bridges Division	1,549	1,437	1,387	1,351	-198
Town of Twin Bridges	509	613	437	374	-135
Virginia City Division	333	261	308	268	-65
Town of Virginia City	194	149	192	142	-52

Source: U.S. Department of Commerce, Bureau of the Census, U.S. Census of Population: 1960-1990. Washington D.C. 1992.

c. Towns Versus Unincorporated Areas

The majority of population growth in the Madison Valley Census Division is occurring outside of the Town of Ennis. From 1960 to 1990, the Madison Valley grew by 940 persons. Approximately three-quarters (74%) of this net-increase was outside of Ennis. The trend for most new settlement to occur outside of city and town boundaries is consistent with statewide population patterns.

d: Age Profile

Table A-3 compares the age profiles of Madison County and the Madison Valley with that of the State of Montana. The populations of Madison County and the Madison Valley are older than is typical in Montana. The Madison's older age profile is consistent with the age characteristics of most of Montana's rural areas, and is the result of young people moving to more urban areas. The Madison area has also experienced in-migration of retirement and near retirement age persons, which has added to the size of its older population.

Table A-3
Age Profile Montana, Madison County, Madison Valley
Percent of Total Population
1990

	State of Montana		Madison County		Madison Valley Census Division	
Under 5 Years	59,257	7%	359	6%	97	5%
Ages 5-17	162,847	20%	1,170	20%	361	18%
Ages 18-44	319,837	40%	2,145	36%	812	40%
Ages 45-64	150,627	19%	1,307	22%	423	21%
Ages 65 and Over	106,497	13%	1,008	17%	325	16%
Median Age	33.8		37.8		37.4	

Source: U.S. Department of Commerce, Bureau of the Census, U.S. Census of Population: 1990. Washington D.C. 1992.

e. Income Characteristics

The 1989 per capita income for persons living in the Madison Valley was $13,117. Per capita income was $10,718 for all of Madison County and $11,213 for Montana. The Madison Valley's median household income of $27,134 and median family income of $31,076 also were notably higher than for the county and the state.

Table A-4
Income Profile Montana, Madison County, Madison Valley
1989

Income Measure	State of Montana	Madison County	Madison Valley Census Division
Per capita	$11,213	$10,718	$13,117
Median household	22,988	22,066	27,134
Median family	28,044	26,009	31,076
Median Non-family household	12,502	11,250	21,691

Source: U.S. Department of Commerce, Bureau of the Census, U.S. Census of Population: 1990. Washington D.C. 1992.

Table A-5
Mean Households Income Comparisons by Income Type
Montana, Madison County, Madison Valley
1989

Type of Income	State of Montana	Madison County	Madison Valley Census Division
Wage and salary	$25,575	$21,326	$24,339
Self-employment (non-farm only)	15,270	16,227	19,963
Farm self-employment	13,779	12,696	5,924
Social Security	7,714	6,669	6,761
Public Assistance	3,620	2,930	2,336
Retirement Income	8,435	10,233	15,851

Source: U.S. Department of Commerce, Bureau of the Census, U.S. Census of Population: 1990. Washington D.C. 1992.

Eighteen percent of Madison Valley households had annual incomes in excess of $50,000 compared to 13 percent for Montana. The higher incomes of the Madison Valley is influenced by the in-migration of wealthy people. The mean income for retirement households in the Madison Valley is nearly double the state average.

Even though summary income statistics indicate affluence for many Madison Valley residents, the incidence of poverty is about the same in the Madison Valley as it is for Montana as a whole. About 16 percent of the valley's population had incomes below the poverty level in 1990 (U.S. Department of Commerce, Bureau of the Census, 1992).

f. Housing

The Madison Valley is the location of most of the new housing being built in Madison County. In the 1980s, the valley averaged about 50 new houses year (483 new housing units were located in the valley during the decade). The rate of new housing development appears to be increasing in the 1990s. This is evidenced by an increase of 92 residential telephone customers in the valley between May 1991 and May 1992 (Three Rivers Telephone Cooperative, 1992).

Table A-6 uses 1990 census data to exhibit the housing characteristics of the Madison Valley Census Division. Most striking is that 739 (48 percent) of the census division's 1,532 housing units were vacant at the time of the census (April 1, 1990), and that only 148 of these vacant units were for sale or rent. The area's extraordinary level of housing vacancy results from its large seasonal population.

Also of note is that the median value for an owner occupied house was nearly $70,000, and one fourth of owner occupied houses were valued at greater than $90,000. The median value for a Montana

owner occupied house is $57,000 (U.S. Department of Commerce, Bureau of the Census, 1992).

The median rental cost reported for the Madison Valley is comparable to what is typical in Montana. However, the census data tabulates housing units which are rented on April 1, which are off-season rental prices in Madison County. Rental rates are higher during the summer-time tourist season (Mike Cerino, 1992). Also apparent from the data is that there is a below normal number of year-round housing units available for rent in the valley. Only 20 percent of valley housing units were rentals.

Table A-6
Madison Valley Housing Characteristics

Total Housing Units	1,532
Occupied Housing	793
By Owner	509
By Renter	284
Vacant	739
For Rent	123
For Sale	23
Rented or Sold (no occ.)	11
For Seasonal Use Only	515
Other Vacant Not for Sale or Rent	277
Housing Values	
Owner Occupied Housing Prices	
Lower Value Quartile	$51,000
Median Value	69,200
Upper Value Quartile	91,300
Renter Occupied Monthly Rents	
Lower Value Quartile	$ 201
Median Value	256
Upper Value Quartile	317
Units in Housing Structure	
Single Family Detached	885
Single Family Attached	18
Multi Family	421
Mobile Home/Trailer	184
Other	24

Source: U.S. Department of Commerce, Bureau of the Census, U.S. Census of Housing: 1990. Washington D.C. 1992.

The affordability of housing was identified as a problem by Ennis members of the Jack Creek Task Force. Recent increases in the prices of local housing have made it expensive for some working people to live in the Ennis area (Jack Creek Task Force Members, 1992).

The influence of the local housing industry on the area economy is illustrated by the fact that 11 percent of the Madison Valley labor force works in the construction sector, compared to 6 percent for Montana (U.S. Department of Commerce, Bureau of the Census, 1992). New housing development in the Madison Valley also supports numerous jobs in building supply, real estate, and home finance businesses.

g. Population Projections

Irrespective of whether the Jack Creek Road is built, Madison County and the Madison Valley are likely to experience further population growth. Table A-7 displays population projections based on recent trends. Madison County's population is predicted to be 6,459 in 2000, 6,949 by 2010, and 7,434 in 2020. Most of this growth will be in Madison Valley and most of it will be outside of the Town of Ennis. It is possible that growth will be greater than is forecasted using the historic trends.

Table A-7
Population Projections Madison County, Madison Valley Census Division, and the Town of Ennis
2000, 2010, 2020

	Madison County	Madison Valley	Town of Ennis
1990	5,989	2,018	773
2000	6,459	3,293	917
2010	6,949	2,813	1,053
2020	7,434	3,232	1,189

2. Madison County Economic Characteristics

Data Sources

In the following analysis, income and employment data are used to characterize the Madison County economy. The most comprehensive economic data for Montana counties is provided by the Regional Economic Information System (REIS), published by the U.S. Department of Commerce's Bureau of Economic Analysis. The data base provides statewide and county specific information on personal income and employment. The data base series covers the 1969-1989 time period. Other major data sources are the annual and quarterly "Montana Employment, Wages and Contributions" reports published by the Montana Department of Labor and Industry. Unless otherwise stated, income data in this section are adjusted for inflation using an implicit price deflator and are presented in 1989 dollars.

a. Employment Trends:

From 1969 to 1989, the average annual employment in Madison County grew from 2,238 to 3,049, a 20-year increase of 36

percent. Growth in employment in Madison County was much greater than in most of Montana's rural counties (U.S. Department of Commerce, Bureau of Economic Analysis, 1991).

The percent of Madison County residents participating in the labor force is increasing. In 1969, an average of 45 percent of county residents were employed, in 1989 51 percent of county residents were employed. The portion of the Madison County population in working age groups has increased. Also contributing to a higher rate of employment is increased labor force participation by women.

Table A-8 displays county employment data for 1969, 1979, and 1989. Albeit declining, agriculture continues to be the single greatest source of employment for county residents. The table demonstrates that recent job losses in agriculture have been offset by job growth in most other economic sectors. Mining, transportation services, construction, retail trade, and services are the economic sectors which have experienced the greatest job growth.

Table A-8
Full- and Part-time Employment by Economic Sector
Madison County
1969, 1979, 1989

	1969	1979	1989	20-Year Change
Total Employment	2,238	2,653	3,049	+811
Farming	823	780	748	-75
Ag.& Forest, Fishing Serv.	25	51	102	+77
Construction	58	160	199	+141
Industrial (Mining & Mfg.)	109	208	246	+137
Transportation & Utilities	32	79	137	+105
Wholesale Trade	61	36	16	-45
Retail Trade	300	341	453	+153
Finance, Insurance, R.Estate	64	126	128	+64
Services	341	390	535	+194
Federal Government Civilian	64	71	86	+22
Federal Government Military	41	39	35	-6
State and Local Government	363	372	364	+1

Source: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System, Washington, D.C. 1991.

b. Unemployment Rates and Seasonal Differences in Employment

The average annual unemployment rates for Madison County are consistently about two percentage points below the state average. For instance, the county's average annual unemployment rate in 1991 was 5.0 percent compared to 6.9 percent for the state. However, Madison County's below average annual unemployment rate belies significant seasonal variation in employment and unemployment. Table A-9 illustrates the county's yearly cycle of employment peaking in the summer and lapsing in the winter.

summertime unemployment rates are very low, in the winter county's unemployment rates are high.

Table A-9
Monthly Variation in Labor Force, Employment, and Unemployment
Madison County
1991

	Labor Force	Employment	Unemployment	Unemployment Rate
Jan.	2,746	2,552	194	7.1%
Feb.	2,739	2,520	219	8.0%
Mar.	2,782	2,586	196	7.0%
Apr.	2,861	2,714	147	5.1%
May	2,850	2,720	130	4.6%
June	3,188	3,068	120	3.8%
Jul.	3,346	3,276	88	2.6%
Aug.	3,330	3,247	83	2.5%
Sep.	3,134	3,022	112	3.6%
Oct.	2,833	2,727	106	3.7%
Nov.	2,691	2,555	136	5.1%
Dec.	2,824	2,590	234	8.3%
Annual Average	2,945	2,798	147	5.0%

Source: Montana Department of Labor and Industry, Montana Labor Market Information, Statistics in Brief, Monthly Reports for 1991.

The seasonal variations in employment and unemployment primarily are due to the summertime focus of the county's tourism industry. Tourism's effect on county employment is further illustrated in Table A-10, which displays quarterly employment in tourism oriented economic sectors. The employment data used in Tables A-9 and 10 do not include proprietors and self-employed persons who do not participate in the state's unemployment insurance program.

Table A-10
Quarterly Employment in Selected Economic Sectors
Madison County
1990

	Jan-Mar.	Apr-June	July-Sep.	Oct.-Dec.
Retail	249	274	335	250
Services	141	194	300	166

Source: Montana Department of Labor and Industry, Employment and Wages, Quarterly Reports for 1990.

In the March 16, 1992 meeting with Ennis members of the Jack Creek Task Force, Ennis merchants discussed the difficulties of operating businesses in a highly seasonal economy. In summers, motels, restaurants, and other retail and service-type businesses operate at near capacity and there is a shortage of labor. Conversely, many local businesses suspend operations in the off-season. Businesses which remain open year-round operate with

much lower sales and payrolls during the non-tourist season (Jack Creek Task Force Meeting, 1992).

c. Total Personal Income

Total personal income is the sum of earnings and non-earnings income. Earnings income includes wage and salary compensation paid to employees, payments to contracted labor, commissions, and the profits of business and agricultural proprietors. Non-earnings income includes personal income resulting from returns on investments (primarily from dividends, interest, and rent receipts) and income from transfer payments (derived mainly from government payments to individuals).

Total personal income for Madison County residents grew from $42.9 million in 1969 to $73.2 million in 1989. Total income grew faster than the county's population causing annual per capita income to increase from $8,500 in 1969 to $13,000 in 1989 (U.S. Department of Commerce, Bureau of Economic Analysis, 1991).

An unusual characteristic of the Madison County economy is the high percentage of personal income which is obtained from non-occupational sources (non-earnings income). In 1989, 60 percent of statewide personal income was derived from occupational earnings and 40 percent was from non-earnings. In Madison County, 51 percent of income was obtained from earnings and 49 percent was from non-earnings.

From 1969 to 1989, Madison County resident income from investments grew by 148 percent and income from transfer payments by 175 percent. During the same period earnings income grew by only 29 percent.

Table A-11
Components of Total Personal Income
Madison County
1969, 1979, 1989
(in millions of 1989 $)

	1969	1979	1989	20-Year Change
Total Personal Income	$42.9	$69.7	$73.1	+$30.2
Earnings (by Place of Residence)	29.1	40.7	37.5	+8.4
Non-Earnings	13.8	29.0	35.6	+21.8

Source: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System, Washington, D.C. 1991.

Growth in investment and transfer payment income in Madison County is a result of in-migration of wealthy people and also the aging of the county's indigenous population. Persons in retirement and near retirement age groups tend to receive the greater shares of their income from investments and transfer payments than do younger people.

Table A-12
Percent of Total Personal Income by Income by Category
Madison County
1989

	Income in Millions $	Percent of Total Income
Total Personal Income	$73.2	100%
By Category of Income		
Earnings (by Place of Residence)	37.5	51%
Investment Income	20.6	28%
Transfer Payment Income	15.1	21%
Farm and Non-farm		
Farm Income	6.4	9%
Non-Farm Income	66.8	91%
Earnings (by Place of Work)	38.2	52%
Wage and Salary Income	25.8	35%
Other Labor Income	2.5	3%
Proprietor Income	9.9	14%
Farm	3.0	4%
Non-farm	6.9	9%
Private and Public Sector Earnings		
Private (Non-farm)	24.4	33%
Government	7.4	12%

Source: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System, Washington, D.C. 1991.

d. Components of Earnings Income:

Total personal earnings in Madison County tend to vary from year-to-year. The variation is largely due to unevenness in the earnings in local agriculture. Most agriculture in Madison County is cattle ranching. Changes in annual farm income have paralleled the dramatic up and down cycles in cattle prices. For much of the 1980s, low cattle prices depressed agricultural earnings. During the 1970s, the county's agricultural sector averaged $10.2 million in annual earnings, in the 1980s the sector averaged $4.2 million in annual earnings.

Depressed earnings in agriculture have been devastating to the economies many of Montana's small agrarian-based economies. The poor performance of Madison County agriculture was in part offset by growth in other economic sectors. The growth in talc mining, construction, and trucking industries and expansion of tourism

helped to sustain the local economy. From 1969 to 1989, non-farm earnings increased by 61 percent. Table 13 displays occupational earnings by economic sector for 1969, 1979, and 1989.

Table A-13
Earnings Income by Economic Sector
Madison County
1969,1979,1989
(in millions of 1989 $)

	1969	1979	1989	20-year Change
Total Earnings by Place of Work	$29.6	$40.0	$38.2	+$8.6
Farm	9.8	12.4	6.4	- 3.4
Non-farm	19.8	27.6	31.8	+12.0
Ag,Forest,Fishery Serv.	0.4	0.8	0.8	+ 0.4
Industrial (Mining & Mfg.)	1.9	4.4	6.6	+ 4.7
Construction	1.0	3.5	3.1	+ 2.1
Trans,Communications,Ut.	0.6	1.8	2.7	+ 2.0
Wholesale Trade	0.3	0.8	0.3	- 0.1
Retail Trade	3.9	3.8	4.0	+ 0.1
Finance,Insur.,Real Estate	1.2	1.5	1.0	+ 0.2
Services	4.4	3.9	6.1	+ 1.7
Federal Civilian	1.5	1.7	1.8	+ 0.4
Federal Military	0.2	0.2	0.3	+ 0.0
State and Local Gov.	4.5	5.2	5.4	+ 0.9

Source: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System, Washington, D.C. 1991.

A portion of the growth in total employment in Madison County is attributable to the creation of low paying and/or seasonal or part-time jobs. The county's average annual earnings per job decreased from $13,216 in 1969 to $12,538 in 1989 (U.S. Department of Commerce, Bureau of Economic Analysis, 1991).

e. Economic Base

The economic base of an area comprises those economic activities which bring outside income into a local economy. The local expenditure and subsequent circulation of basic income within the economy creates additional jobs and income for area residents.

Agriculture, mining, tourism, and construction (mainly home building) are important contributors to Madison County economic base. Also prominent in the economic base is the sizable investment and transfer payment income accruing to county residents. The forest products industry and transportation services (mainly trucking and warehousing) serve as minor basic industries for the county economy.

Historically, agriculture has been the most important component of the Madison County economic base. Agriculture's ability to

sustain the local businesses and employment is decreasing. The aggregation of farms and ranches, automation of farm labor, the regional marketing of agricultural supplies, and unfavorable market conditions have all contributed to a lessening role for agriculture in Madison County.

The decline in the supportive capabilities of Madison County agriculture has been offset by the growth in basic income from other sources. The talc mining industry been expanding and is a very positive contributor to the economy. Employment and earnings in mining have more than doubled since 1970. Some metal mining also occurs in Madison County.

The county's tourism industry is experiencing steady growth. Madison County's near proximity to Yellowstone Park, the Madison River's reputation for "world class" trout fishing, the county's natural scenery and history, Ennis and Virginia City attractions, bring thousands of visitors to Madison County each summer. The fall hunting season and winter-time special hunting seasons also bring visitors to the area.

Visitor expenditures focus on the retail and service sectors. Certain types of retail and service industries are much more developed in Madison County than is typical of Montana counties having similar populations. Eating and drinking, general merchandise stores, lodging, personal and recreation services businesses, in particular, benefit from visitor expenditures. Many local businesses claim that over half of their sales are to tourists or other non-local residents (Jack Creek Task Force, Jack Creek Business Survey, 1990). Employment and personal earnings in tourism businesses have been increasing.

The reputation of the Madison River attracts a national clientele of fishermen to the Madison Valley. Local outfitters, fishing specialty businesses, and general tourism businesses cater to fisherman in summers. At the meeting with the Jack Creek Task Force, outfitters expressed concern over the effects increased fishing pressure is having on the quality of fishing in the Madison River. The outfitters indicated that continued decline in the quality of fishing could result in the loss of long-time clients (Jack Creek Task Force Members, 1992).

In-migration to Madison County has contributed to a thriving local housing industry. Earnings in the local construction sector is are 60 percent greater than in counties with similar populations (U.S Department of Commerce, Bureau of Economic Analysis, 1991). Because money used to purchase many of the new recreation and retirement homes comes from outside of Madison County, it functions as basic income for the local economy.

The fastest growing contributor to the Madison County economic base is non-earnings income. Trends in non-earnings income are discussed previously (see Income Characteristics). Because most of this income is derived from non-local sources, the expenditure of the non-earnings income functions as basic income. Many

people with substantial investment and transfer payment income are seasonal residents of Madison County. Their contributions to the county's economic base occur during the warm months and exacerbate the seasonal cycles of the county economy.

f. Multiplier Effect

The economic multiplier effect occurs when basic income is spent in a local economy. The circulation of basic income creates jobs and income for other local area residents, who in turn, make local expenditures and which create additional jobs and income. The income multiplier for Madison County is estimated to between 1.20 and 1.30. This estimate was derived using the "Minimum Requirements" and the "Location Quotient" techniques. These are two methods used in economic base theory to identify the ratios of basic to non-basic income in a local economy.

An income multiplier of 1.20 to 1.30 is relatively small. It means that for every dollar of basic income accruing to a county resident, another 20 to 30 cents in earnings is created for other county residents. The small multiplier is typical of Montana counties with less than 10,000 population. The Madison County market is simply too small to support extensive retail or service businesses, or locally oriented wholesale trade and manufacturing. Many Madison County residents purchase significant portions of their food, automobile, apparel, furniture, insurance, real estate, business, medical, and legal goods and services elsewhere. Most non-local purchases are made in Bozeman, which is less than an hour drive from Ennis.

3. Big Sky Population and Economic Characteristics

Comprehensive population and economic data are not available for unincorporated areas such as Big Sky. The ensuing discussion of Big Sky socioeconomic characteristics is based on what data is available from the U.S. Bureau of the Census and the Montana Department of Labor and Industry (DLI). Census and DLI data are supplemented with information obtained from interviews with professionals working in the Big Sky community.

The Big Sky area is defined as the Big Ski Resort, Meadow Village and areas along the Gallatin Canyon approximately 6 miles north and south of the entryway to the resort area.

As a resort community, Big Sky is much different socially and economically from other communities in Montana. The area has about 1,240 houses, condominium units, and motel rooms. During a peak weekend of the ski season an estimated 6,000 to 7,000 people are over-night visitors or residents of the area. In addition, the community hosts hundreds of day time skiers. These people are generally Montana residents commuting to the resort from their home communities, or out-of-state residents staying in Bozeman. The population of Big Sky is much smaller during the remainder of the year. The summertime population peak is estimated at 3,000 to 4,000 (Bill Murdock, 1992).

Only about 500 people live in Big Sky year-round. Most residents are seasonal, one-or-two week or monthly time-sharers, or weekend visitors. Many of these impermanent residents are retirees. (Bill Murdock, 1992) (Taylor Middleton, 1992).

Income data for the Big Sky census subdivision has not yet been published; however, the area's median housing value of $117,900 and the median rent $324 demonstrate that persons residing in Big Sky have much higher incomes than are typical for persons living in Montana (U.S. Department of Commerce, 1992).

Employment in the Big Sky area fluctuates from season to season. During the winter months the area supports over 900 jobs. Tables A-14 and A-15 display average monthly and quarterly employment for persons working within the Big Sky zip code. The employment cycle for Big Sky is somewhat opposite that of the Ennis-Madison County. The number of people employed at Big Sky peaks during the 4-month winter ski season. Employment tails off dramatically in the spring, increases slightly in the summertime tourist and convention season, and tails-off again in the fall. The tables also illustrate the growth in employment which is occurring in the Big Sky area. Note the wintertime and summertime increases in employment from 1990 to 1991. Business activity and employment have been increasing (Taylor Middleton, 1992) (Bill Murdock, 1992).

Table A-14
Average Monthly Employment*
Big Sky, Montana
1990 and 1991

	1990	1991
January	798	884
February	802	916
March	830	932
April	535	487
May	312	297
June	520	579
July	607	673
August	632	707
September	547	595
October	453	Unavailable
November	546	Unavailable
December	744	Unavailable

Source: Montana Department of Labor and Industry, Reseach and Analysis Bureau, Helena, Mt. Employment and Wages Data Base; special computer run. 1992

Table A-15
Average Quarterly Employment and Earnings*
Big Sky, Montana
1990-1991

Quarter	Year	Ave. Monthly Employment	Sum Earnings
1st Quarter (Jan.-Mar.)	1990	810	$2,914,000
2nd Quarter (April-June)	1990	456	1,666,761
3rd Quarter (July-Sep.)	1990	595	2,196,205
4th Quarter (Oct.-Dec.)	1990	581	2,198,733
1st Quarter (Jan.-Mar.)	1991	910	2,860,600
2nd Quarter (April-June)	1991	454	1,481,270
3rd Quarter (July-Sep.)	1991	658	2.391,357
4th Quarter (Oct.-Dec.)	1991	unavailable	

Source: Montana Department of Labor and Industry, Reseach and Analysis Bureau, Helena, Mt. Employment and Wages Data Base; special computer run. 1992

* Totals account for persons employed by Big Sky Resort and those employed by other smaller businesses who are covered under Montana's unemployment insurance compensation system. Not included are self-employed persons and others not covered by unemployment insurance.

The Big Sky community is bisected by the county boundary line separating Gallatin and Madison County. Technically, some of the jobs and earnings at Big Sky area already occur in Madison County and/or benefit Madison County residents. However, there is no convenient road access into the populated areas of Madison County. In a practical sense, nearly all of the economic effects of the Big Sky development are being felt in Gallatin County.

The Boyne Corporation, which owns the Big Sky Ski Resort is by far the area's largest employer. For most of the year Boyne accounts for between 40 and 50 percent of area's jobs. The remaining local workers are employed mainly by businesses which cater to tourists and seasonal residents, or are involved in the area's vigorous real estate/housing construction industry. Approximately 50 condominiums a year are being built in the Big Sky area (Taylor Middleton, 1992).

As a youthful resort community, Big Sky has not yet developed the commercial business infrastructure normally present in a small town in Montana. Big Sky residents tend to purchase many goods and services in Bozeman. This trade provides substantial benefits to the Bozeman area economy. Big Sky does contain a bank, a small school, a grocery store, and a few other general retail and service type businesses.

Many of the jobs in the Big Sky community are relatively low paying. Average annual earnings per job in the Big Sky area are between $14,000 and $15,000. This is often too little income to allow persons working in Big Sky to afford local housing. Many Big Sky workers live in the Bozeman area (Bozeman, Belgrade, and Gallatin Gateway), which is 45 to 65 miles away (Taylor

Middleton, 1992) (Bill Murdock, 1992). This pattern is consistent with worker residence patterns in other Rocky Mountain ski resort areas (Lay Gibson, 1992) (Hank Robison, 1992) (Alan Vigil, 1992) (Lee Neles, 1992).

The long and often-time icy commute through Gallatin Canyon is cited as a reason for employee turnover at the Big Sky Resort (Taylor Middleton, 1992). The fact that so many Big Sky workers live in the Bozeman area also causes the direct and secondary economic benefits of Big Sky development to occur in Bozeman.

B. ECONOMIC IMPACTS OF THE JACK CREEK ROAD

The economic impact analysis assumes that the Jack Creek Road would be built in 1994 and 1995, and would be operational in 1996. Economic effects occurring during construction would be short-term, and would cease when road construction was completed. long-term impacts are examined only for the 1996-2015 time period. The impacts of road operation would likely continue occur beyond this study period. The impact analysis discussion is for the "Desirable Design Road," which is found to have the most positive economic impacts to Madison County and the most favorable benefit-to-cost ratio.

Two types of economic models were used to project the effects of the Jack Creek Road on local employment and earnings. Economic base models were developed for Madison and Gallatin counties using the "minimum requirements" and "location quotient" techniques to identify base-to-non-basic income ratios (Lay Gibson, 1992) (Lay Gibson and J.W. Alexander, 1978). Income multipliers were approximately 1.25 Madison County and 1.50 for Gallatin County.

Input-output models of Madison and Gallatin county economies were developed using the RIMS II input-output coefficients generated by the U.S. Department of Commerce (Richard Beemiller, 1991) (Richard Beemiller, 1989). The "location quotient" technique was used to derive county specific I-O coefficients from statewide multipliers. Local I-O coefficients were further modified as result of information obtained through interviews with Montana contractors and local area business persons.

Gravity models were often used to allocate travel and consumer patterns between communities. Gravity models assume that the distribution of travel and commerce between centers tends to be proportional to their sizes and inversely proportional to relative travel costs.

The results of the economic base and input-output models were generally similar. The employment and earnings projections contained in this economic impacts section are averages of the output of the two models.

The economic analysis assumes that public land use controls or privately imposed restrictive easements would prevent commercial and residential development along new sections of the Jack Creek Road. If such development were allowed to take place it would dramatically change the economic impact of the road in Madison and Gallatin counties.

SHORT-TERM IMPACTS

1. Impacts of Road Construction

The construction of the Jack Creek Road would have positive, but short-term impacts on the Madison and Gallatin county economies. The road's construction would create jobs and income for construction workers and persons supplying goods and services used in construction activities. In addition, local expenditures by persons and businesses involved directly and indirectly in construction would cause secondary economic effects, creating additional jobs and income for local residents.

a. Overview of Construction Expenditures and Schedule

The construction of a high quality road through Jack Creek Canyon road is expected to cost $21.5 million and take two years to build. It is assumed that the project would be built using one spread, with the staging area located on the Ennis side of the Madison Range. Labor requirements and purchases of materials and supplies are assumed to be evenly allocated over the construction period. During actual construction, weather and contractor preferences could cause purchases and workforce characteristics to vary from month to month and year to year.

b. Direct Employment and Earnings

Approximately 25 percent of the costs of road construction are typically expended on labor (Gilman Excavating Co., 1992) (Washington Corp.,1992). Total labor costs for the Jack Creek project are estimated at $5.5 million, which would create about 215 person-years of employment.

During 1994 and 1995, road building would create an average of 108 on-site jobs with an annual payroll of $2.7 million. The workforce would consist of about 5-10 management and professional workers, 65-75 skilled laborers, and 15-25 unskilled laborers. Skilled workers would mainly be equipment operators and truck drivers. Carpenters, ironworkers, and cement finishers would be hired for bridge work. Unskilled workers would mainly be manual laborers (Gilman Excavating Co., 1992) (Washington Corp., 1992).

Average wages are expected to be $14.00 to $16.00 an hour for skilled labor and about $12.00 for unskilled labor. Additional employee benefits are estimated being worth $3.00 to $4.00 an hour. Management and professional staff are generally salaried positions (Gilman Excavating Co., 1992) and (Washington Corp., 1992).

Most persons directly employed in constructing the Jack Creek Road would be from outside of Madison and Gallatin Counties. Project construction would require a large and sophisticated contractor or consortium of contractors. Montana's largest highway contractors are located in Billings, Great Falls, Butte and Missoula. These companies have permanent management and

professional staffs. The large construction companies also have established hiring relationships with many skilled laborers. All management and professional jobs and most skilled labor construction jobs would be filled by persons from outside of the local labor markets. A few skilled workers could be hired from the local labor pool (Gilman Excavating Co., 1992) (Washington Corp., 1992).

The winning contractor would attempt to hire most unskilled laborers locally (Gilman Excavating Co., 1992) (Washington Corp., 1992). A few Madison County residents were hired by contractors rebuilding segments of U.S. Highway 287 near Ennis (Jack Creek Task Force Meeting, 1992) and a small number of Madison County construction workers are also likely to be hired to build the Jack Creek Road project. Much of the remaining unskilled labor would be recruited from Gallatin County.

Table B-1
Predicted Construction Work Force Origination
By Job Category
For 1993 and 1994

	Madison County	Gallatin County	Non-Local Montana	Montana Total
Management & Professional	0	0	8	8
Skilled Labor	5	11	73	89
Unskilled Labor	4	7	0	11
Total Jobs	9	18	81	108

Labor union contracts with road the construction contractors could restrict the hiring of local persons even for unskilled construction jobs. Most union members reside outside of the Madison-Gallatin County labor market.

b. Indirect Economic Effects

The major non-labor costs of project construction are expected to include gravel, asphalt, culverts, concrete, bridging materials, signing, paint, and heavy equipment. Contractor expenditures for construction supplies, materials and services would indirectly create earnings and employment.

Table B-2 displays dollar value estimates for major construction inputs necessary to build the new road. The table also comments on the likelihood that the inputs would be purchased from within Montana and Madison and Gallatin counties.

Table B-2
Estimated Expenditures for Selected Construction Materials and Supplies
(Input costs are in millions of 1992 $)

Materials & Supplies	Total Value	Likely Procurement w/i Montana	Likely Procurement w/i Madison or Gallatin County
Gravel	$ .700	All	All
Paving Materials	1.100	All	None
Drain Pipe/Culverts	.200	All	None
Concrete & Bridge Matr.	.100	All	Part
Signing & Paint	.200	All	None

Sources: Washington Corp., Gilman Excavating Co., Robert Peccia and Associates, 1992

Table B-3
Estimated Expenditures for Heavy Equipment
(Input costs are in millions of 1992 $)

	Total Cost	Likely Procurement w/i Montana	Likely Procurement w/i Madison or Gallatin County
Heavy Equipment *	$ 6.900	Part	None

* construction equipment is generally owned or leased by in-state construction companies, but is manufactured out of state.

Sources: Washington Corp., Gilman Excavating Co., Robert Peccia and Associates, 1992

Most expenditures for construction materials, suppliers and services would be made outside of Madison or Gallatin county (Gilman Excavating Co., 1992) (Washington Corp., 1992). This would cause most indirect jobs and earnings to be generated elsewhere in Montana or out-of-state.

Gravel and concrete would be purchased from within the Madison-Gallatin County area. The contractor would pay a land owner(s) for the right to extract gravel from a location near the construction site. The contractor would mine, crush and transport the gravel using its own personnel and equipment. Concrete would be purchased from a local ready mix plant. The concrete sales would result in a small increase in earnings and

labor (employment) at the plant. The contractor could also be expected to make minor purchases of replacement tools (e.g. shovels), equipment parts, and miscellaneous goods and services from the local area (Gilman Excavating Co., 1992) (Washington Corp., 1992) (Robert Peccia and Associates).

c. Secondary Economic Effects

Most construction workers would be non-local residents and most materials, supplies and services would be procured from elsewhere. These factors would cause secondary economic benefits of Jack Creek Road construction to occur outside of Madison and Gallatin Counties. The small size of Madison County's economic multiplier also would restrain secondary economic effects in this county.

Expenditure patterns for non-local workers are different from those of permanent residents of a community. Non-local construction workers tend to save much of their earnings to be spent in their home communities. Local workers spend most of their earnings locally.

Madison County eating and drinking establishments, lodging providers (including trailer courts), and certain retail businesses would benefit from the expeditures of non-local workers. The Gallatin County economy would also benefit from some of these expenditures.

d. Projections of the Economic Impacts of Road Construction

Table B-3 displays projections of economic impacts of Jack Creek Road construction. Road building is predicted to create an average of 31 total jobs for residents of Madison County and 43 total jobs for residents of Gallatin County for two years. Another 81 jobs would be located in Madison County but would be filled by non-local workers. Projections assume non-local workers would spend half of their earnings in Madison and Gallatin Counties and the remainder in their home communities. An estimated 117 indirect and secondary jobs would be located elsewhere in Montana.

During the two years of construction, the project would increase the total income of Madison County residents by 0.6 percent and lower the county's average annual unemployment rate by about 1 percent. Construction would increase Gallatin County income and lower unemployment by about 0.1 percent.

Table B-4
Employment and Earnings Impacts of Project Construction by Local, County, and Non local

Employment Impacts

	Direct Employment	Indirect & Secondary Employment	Total Employment
1994			
Totals	108	164	272
Madison Co Res.	9	22	31
Gallatin Co. Res	18	25	43
Non-local (Montana)	81	117	198
1995			
Totals	108	164	272
Madison Co Res.	9	22	31
Gallatin Co. Res	18	25	43
Non-local (Montana)	81	117	198

Earnings Impacts
(in millions of 1992 $)

	Direct Earnings	Indirect & Secondary Earnings	Total Earnings
1994			
Totals	$2.688	$2.191	$4.879
Madison Co Res.	.202	.277	.479
Gallatin Co. Res	.403	.375	.778
Non-local (Montana)	2.083	1.539	3.622
1995			
Totals	$2.688	$2.191	$4.879
Madison Co Res.	.202	.277	.479
Gallatin Co. Res	.403	.375	.778
Non-local (Montana)	2.083	1.539	3.622

e. Funding Considerations

Source of funding for construction of the Jack Creek Road is uncertain. If the road is funded all or in part by the federal monies, the contribution to project costs will serve as basic income for the Montana economy. If the federal funds would otherwise not be spent in Montana, the project would result in net economic benefit for the state. If the federal funding for the Jack Creek Road resulted in other Montana road projects not being funded, the economic benefits accruing to Madison and Gallatin counties would simply be a reallocation of economic benefits within the state. The employment and earnings gains in Madison and Gallatin County would be at the expense of other county economies.

LONG-TERM IMPACTS

2. Big Sky Worker Relocation

a. Local Economic Implications of Changes in Place of Residence for Big Sky Workforce

The Jack Creek Road would make it possible for people working at Big Sky to live in Ennis. Given the high housing costs in Big Sky and a the long and difficult commute from the Bozeman area, Ennis would pose an attractive residence alternative for many Big Sky workers.

A Jack Creek Road could induce a significant number of Big Sky workers to live in Ennis. This change in place of residence would have positive economic effects on the Madison County economy. However, the Jack Creek Road would not result in a notable increase in total employment in Big Sky. Most of the economic benefits occurring in Madison County would be at the expense of the Gallatin County. Direct earnings and secondary economic impacts would shift from one local economy to another.

b. Road Effects on Employee Place of Residence

A $21.5 million, 50-mile per hour road design would allow for a 30-minute wintertime commute from Ennis to Mountain Village (the Big Sky ski hill) and a 42 minute commute from Ennis to Meadow Village. The commute times from Ennis would be faster than from Bozeman, Gallatin Gateway, and Belgrade, making the Ennis area viable residence alternative for Big Sky workers.

Table B-5
Comparison of Winter Travel Times
Assuming a 50-MPH Road Design Between Ennis and Big Sky
(travel times are in minutes)

	Mountain Village	Meadow Village
Ennis	30	42
Bozeman	67	55
Gallatin Gateway	57	45
Belgrade	67	55

Sources: Shawn Foutch, Robert Peccia and Associates 1992.
Bill Murdock, Big Sky Property Owners Association, 1992.

A manager at the Big Sky resort suggested that a road connecting Ennis and Big Sky would prompt 150-200 Big Sky area workers to live in Ennis (Taylor Middleton, 1992). The contention that people would commute from Ennis to Big Sky is supported by a gravity model used to simulate the road's effects on the geographic distribution of 1991 Big Sky area workforce. The model considers travel times and housing costs, and uses population as a proxy for relative community attraction. The simulation assumes that 60 percent of Big Sky workers would live in Big Sky irrespective of whether a road is built. The latter

assumption is based on a 1986 survey of Big Sky residents and observations made by Big Sky area professionals (Bill Murdock, 1992) (Taylor Middleton, 1992), (Mike Richards, 1992).

Table B-6
Simulation of Effects of Jack Creek Road on the Place of Residence of 1991 Big Sky Workers
(based on 1991 workforce)

	Total Workers	Ennis	Bozeman Belgrade Gal.Gateway	Big Sky
Winter	910	111	243	556
Spring	454	44	97	313
Summer	658	77	106	406
Fall	631	74	169	390
Annual Ave.	663	77	171	416

The commuting advantage from Ennis would be greatest for jobs located at the Big Sky ski hill. Most Ennis residents working in Big Sky would be employed by the ski resort or other Mountain Village business. Many of these jobs would be seasonal. Big Sky area would employ 111 Ennis residents in the winter, 44 in the spring, 77 in the summer, and 74 in the fall. The average number of Ennis residents working at Big Sky would be 77.

Table B-7 displays projections of worker location by county from 1995 to 2015. The projections assume that the Jack Creek Road would be operational in 1996. Regression analysis is used to project the long-term growth in employment in the Big Sky area. By 1996, the average annual workforce at Big Sky will approach 775 and the peak ski season workforce will approach 1,100.

Table B-7
Estimated Average Annual Employment and County of Residence
Big Sky, Montana
For Selected Years 1995-2015

	Average Annual Employment	Residents of* Gallatin County	Residents of Madison County
1995	743	743	0
2000	851	753	98
2005	954	844	110
2010	1,058	936	122
2015	1,161	1,027	134

* estimates include some Madison County residents living within the Big Sky zip code.

It would take several years for the predicted changes in employee place of residence to occur. Projections assume that initial shifts in the place of employee residence jobs would occur gradually during the first 5 years of the road's operation, thereafter Madison County would house a constant share of Big Sky workers.

c. Economic Effects of Changes in the Places of Residence of Big Sky Employees on the Madison County Economy

The relocation of Big Sky employees to Ennis would have a positive impact on the Ennis and Madison County economies. The earnings of Big Sky workers residing in the Ennis area would function as "basic income." Their local expenditures would create additional jobs and income for other Madison Valley residents. Table B-8 displays projected income and employment effects resulting from the relocation of Big Sky workers to Madison County.

Table B-8
Economic Impacts of Worker Relocation in Madison County
For Selected Years 1995-2015

Average Annual Increase in Employment of Madison County Residents

	Direct Employment at Big Sky	Secondary Employment	Total Employment
1995	0	0	0
2000	98	21	119
2005	110	23	133
2010	122	26	148
2015	134	28	162
20-Year Annual Ave.	111	23	135

Estimated Annual Increase in Earnings by Madison County Residents (in millions of 1992 $)

	Direct Earnings at Big Sky	Secondary Earnings	Total Earnings
1995	$ .000	$ .000	$ .000
2000	1.474	0.309	1.783
2005	1.653	0.347	2.000
2010	1.833	0.385	2.217
2015	2.012	0.423	2.435
20-Year Annual Ave.	$1.670	$ 0.351	$ 2.020
20-year Totals	$33.391	$7.012	$40.403

Estimates were developed using economic base and input-output models of the Madison County Economy.

The effects of worker relocation would be noticeable in Madison County. During a 20-year study period, relocated Big Sky workers would increase the annual personal income of county residents by about 2.3 percent and average annual employment by about 3.7 percent. Because many jobs at Big Sky will continue to be seasonal, the greatest levels of employment and earnings would occur in the winter months. This employment pattern would reduce Madison County's wintertime unemployment. Local expenditures by

Big Sky workers would help Ennis businesses which have difficulty sustaining their operations during the winter.

d. Economic Effects of Changes in the of Places of Residence of Big Sky Employees on the Gallatin County Economy

The Gallatin County economy is expected to grow irrespective of the development of the Jack Creek Road. The relocation Big Sky workers to Madison County would cause a slight reduction in the amount of growth which will. The Gallatin economy would lose the direct jobs and earnings and some of the secondary economic effects induced by expenditures of Big Sky workers (worker households may still make some purchases in Gallatin County).

Table B-9
Economic Impacts of Worker Relocation in Gallatin County
For Selected Years 1995-2015

Average Annual Decrease in Employment in Gallatin County

	Direct Employment at Big Sky	Secondary Employment	Total Employment
1995	0	0	0
2000	- 98	-38	-136
2005	-110	-42	-152
2010	-122	-47	-169
2015	-134	-51	-186
20-Year Annual Ave.	-111	-42	-154

Estimated Annual Decrease in Earnings in Gallatin County (in millions of 1992 $)

	Direct Earnings at Big Sky	Secondary Earnings	Total Earnings
1995	$ .000	$ .000	$ .000
2000	-1.474	-0.565	-2.039
2005	-1.653	-0.634	-2.287
2010	-1.833	-0.703	-2.535
2015	-2.012	-0.772	-2.784
20-Year Annual Ave.	-$ 1.670	-$ 0.640	-$ 2.310
20-year Totals	- $33.391	-$12.805	-$46.196

During a 20-year study period, the relocation of Big Sky workers would decrease the total personal income of Gallatin County residents by about 0.3 percent a year and average annual employment by about 0.6 percent.

3. Skier Lodging in Ennis

a. Overnight Lodging Facilities

The Jack Creek Road would allow skiers to stay in overnight lodging facilities in Ennis. Ennis has 6 motels offering 126 rooms for rent. Throughout the summer tourist season local

motels are booked at or near capacity. During the off season two of the motels close completely, and two others reduce the number of rooms they rent. In the off season, the available motel rooms are about 60 percent occupied on week days and 10 to 20 percent occupied on weekends. The motel rooms do tend to fill up during the fall hunting season and during special permit hunting seasons in the early winter (Mike Cerino, 1992).

Table B-10
Ennis Motels and Motel Rooms for Rent During Summer and Winter 1992

Motel	Summer Rooms	Winter Rooms
Sportsman	35	4
El Western	28	0
Hickeys	22	13
Rainbow	18	18
Riverdale	14	0
Silvertip	9	9
Total Rooms	126	44

Source: Mike Cerino, Ennis, Mt.

b. Market for Lodging Services

The skiers most likely to stay overnight in Ennis would be residents of western Montana. On-site lodging at the Big Sky Ski Resort is too expensive for many Montanans, and the motel rooms in Ennis would provide a more affordable alternative. The Big Sky Resort feels that the availability of lodging in Ennis would increase the total number of skiers at the resort (Taylor Middleton, 1992). Some of this increase could be at the expense of rival ski resorts.

The rerouting of traffic from the Gallatin Canyon to the Jack Creek Road might also relocate the place of over-night lodging for persons who would otherwise stay over-night in Gallatin Gateway or Bozeman motels. This change would be to the detriment of the Gallatin County businesses.

The Ennis members of the Jack Creek Task Force generally agreed that local motels would be used by in-state skiers on weekends. One member felt that community would be able to attract overnight skiers by offering ski packages. Another member estimated that road development would result in 80 percent occupancy of motels on ski season weekends. Local businesses, such as restaurants could be expected to benefit from the expenditures of skiers staying in Ennis (Jack Creek Task Force meeting, 1992).

Table B-11
Estimated Additional Motel Room Occupancy During Ski Season By Rental Night

Year	Additional Rooms Rented
1995	0
2000	1,985
2005	3,969
2010	4,442
2015	4,914
20-Year Annual Ave.	3,336

c. Employment and Income Effects

Table B-12 displays projections of the economic impacts to Madison County resulting from overnight lodging by skiers. By 2005, over 200 skiers would be staying in Ennis on weekends. Local employment and earnings impacts would be concentrated in December through March ski season. The projections assume the motel users would make 50 percent of eating and drinking expenditures in Ennis.

The economic projections assume that skier use of Ennis motels would begin in 1996 and increase steadily until 2005. In 2005, all of the existing Ennis motels would be completely open on the weekends, and 80 percent filled by skiers. The 2005 projections also assume that 10 percent of the rooms would be filled by skiers during weekdays. Projections also assume and that a new 30-room motel would be built in Ennis in 2006.

Table B-12
Economic Impacts of Motel Use by Big Sky Skiers
In Madison County
For Selected Years 1995-2015

Annual Increase in Ski Season Employment and Year-round Equivalent Employment in Madison County

	Seasonal Employment			Total
	Ski Season Direct Employment	Ski Season Secondary Employment	Ski Season Total Employment	Year round Equivalent Employment
1995	0	0	0	0
2000	6	2	7	2
2005	11	4	15	5
2010	12	4	17	6
2015	14	5	18	6
20-Year Annual Ave.	9	3	12	4

Average Annual Increase in Personal Earnings in Madison County
(in millions of 1992 $)

	Direct Earnings	Secondary Earnings	Total Earnings
1995	$ 0	$ 0	$ 0
2000	.027	.009	.036
2005	.055	.018	.073
2010	.061	.020	.081
2015	.068	.022	.090
20-Year Annual Ave.	$ .046	$ .015	$ .061
20-Year Totals	$ .923	$ .300	$1.223

4. Day Trips to Madison County

a. Expenditure Patterns

Another way in which the Jack Creek Road could benefit the Madison County economy is by facilitating day trips by Big Sky residents and visitors. Day trip expenditures would particularly profit Madison County businesses catering to tourists.

Travel from Big Sky to Ennis and Madison County would mainly be by automobile. Table B-13 reproduces data on average daily expenditures by season for out-of-state visitors to Montana traveling by car. The information was developed by the Montana Institute for Tourism and Recreation Research. No comparable

data is available for the travel expenditures of in-state residents. Most persons traveling from Big Sky would spend only a portion of their day in Madison County. Lodging and many other purchases would continue to be made in the Big Sky community.

Table B-13
Average Daily Expenditures per Group for Highway Travelers by Season and Type of Expenditure
1988-1989

	Spring 1988	Summer 1988	Fall 1988	Winter 1989
Gasoline	$12.11	$14.40	$12.30	$8.81
Groceries	4.91	3.37	3.49	4.20
Food Service	11.52	12.60	12.96	12.24
Hotel/Motel	12.25	13.16	12.74	12.49
Campground	1.53	2.28	.25	.09
Rental Auto/RV	.20	.19	.07	.13
Auto/RV Repair	1.81	1.60	.49	1.15
Transportation	1.22	.06	.45	.83
License/Admission	.95	1.23	.22	.58
Rec.Equip	3.31	.94	1.00	2.15
Outfitter/Guide	.09	.52	10.23	5.16
Retail	20.99	11.98	20.35	20.67
Doctor/Dentist	*	*	.17	*
Total	$71.22	$64.31	$74.54	$72.88

Source: Moisey, Neil, and Michael Yuan, Institute for Tourism and Recreation Research, University of Montana. "Estimates of Economic Impact of Non-Resident Travelers to Montana; a Technical Report;" Research Report 11, Missoula, Mt. April, 1990.

The change in commerce patterns encouraged by the Jack Creek Road would not create significant new tourism expenditures in Montana. Most additional expenditures made in Madison County would likely replace expenditures which would otherwise be made in Big Sky, Bozeman, West Yellowstone or elsewhere in Montana. Likewise, most increased expenditures at Big Sky by Madison County residents would replace expenditures in Ennis or elsewhere in Montana. The chief economic effect of the road would be to re-allocate earnings and employment among local economies.

b. Estimates of Visitor Group Days

It is speculative as to how extensive travel would be between Big Sky and Ennis. Many visitors to Big Sky arrive by plane and shuttle service. Plane travelers would need to rent cars to traverse the Jack Creek Road. The expense, inconvenience, and availability of rental cars, and/or the lack of knowledge of Madison County attractions would restrict air travelers from making the Jack Creek trip. These constraints would not affect Big Sky residents; most residents would have access to vehicles and an awareness of Madison County attractions.

Table B-14 presents projections based on an assumption that 1 percent of Big Sky resident and overnight visitor days would involve travel to Madison County via the Jack Creek Road. Projections also assume travel groups would average 3 persons.

Table B-14
Estimated Annual Day-Trips from Big Sky to Ennis
1995-2015

	Visitor Group Days
1995	0
2000	7,602
2005	8,083
2010	8,960
2015	9,839
20-Year Annual Ave.	8,163

Big Sky visitors to Madison County would begin 1996 and gradually increase. By 2000, an average of 20 groups a day would be commuting from Big Sky to the Madison County Valley via the Jack Creek Road. By 2015, 27 travel groups a day would make the trip. Because of seasonal variations in the Big Sky population, most Big Sky originated travel on the Jack Creek Road would occur during the ski season or summer. The economic impacts in Madison County would be concentrated during summer and winter months.

The new tourist trade would particularly benefit Ennis businesses providing eating and drinking services, general and convenience groceries, businesses providing motor fuel, souvenirs and gifts, recreation equipment and services, and clothing (Neil Moisey and Michael Yuan, 1990).

The Virginia City area's tourist attractions and museums and galleries could also experience business growth. Fishing outfitters could experience increase in demand for their services, but the limits on the carrying capacity of the area's fishing resource may limit potential for expansion of the local outfitting industry. Some outfitters fear that increased fishing pressure on the Madison River will further harm the quality of local fishing and have long-term adverse effects on the local fishing industry (Jack Creek Task Force Meeting, 1992).

c. Employment and Income Effects of Day Trips on Madison County

Employment and income projections assume each travel group would spend approximately $30.00 in Madison County and that purchases would be limited to day trip type expenditures (i.e food and beverages, retail goods, and personal services).

Table B-15
Economic Impacts of Big Sky Resident and Visitor Expenditures in Madison County
For Selected Years 1995-2015

Average Annual Increase in Employment in Madison County

	Direct Employment	Secondary Employment	Total Employment
1995	0	0	0
2000	5	1	6
2005	6	2	7
2010	6	2	8
2015	7	2	9
20-Year Annual Ave	6	2	7

Average Annual Increase in Personal Earnings in Madison County (in millions of 1992 $)

	Direct Earnings	Secondary Earnings	Total Earnings
1995	$ 0	$ 0	$ 0
2000	.075	.021	.096
2005	.084	.023	.107
2010	.094	.026	.119
2015	.103	.028	.131
20-Year Annual Ave.	$.085	$ .023	$ .109
20-Year Totals	$1.704	$ .467	$2.171

It is possible that the number of Big Sky travelers to Madison County would be much lower or higher than assumed. An assumption that 0.5 percent of the resident and visitor days would involve travel to Madison County projects to an increase of $48,000 in annual earnings and 3 year-round equivalent jobs in Madison County in 2000. An assumption that 2 percent of Big Sky visitor and resident days would involve day-trips to Madison County projects an earnings increase of $192,000 and an average of 13 year-round equivalent jobs in 2000.

d. Employment and Income Effects of Day Trips on Gallatin County

Expenditures by Big Sky residents and visitors in the Madison Valley would be lost revenue for businesses in other communities. Most of this loss would accrue to businesses in Big Sky, and possibly in Bozeman and West Yellowstone which are the likely destinations of current day trips. The transfer of expenditures to Madison County would result in a loss of jobs and earnings in Gallatin County.

Table B-16
Economic Impacts of Lost Resident and Visitor Expenditures in Gallatin County
For Selected Years 1995-2015

Average Annual Decrease in Employment in Gallatin County

	Direct Employment	Secondary Employment	Total Employment
1995	0	0	0
2000	-5	-3	- 8
2005	-6	-4	-10
2010	-6	-4	-10
2015	-7	-5	-12
20-Year Annual Ave	-6	-4	-10

Average Annual Decrease in Personal Earnings in Gallatin County (in millions of 1992 $)

	Direct Earnings	Secondary Earnings	Total Earnings
1995	$ 0	$ 0	$ 0
2000	-.075	-.051	-.126
2005	-.084	-.058	-.144
2010	-.094	-.063	-.157
2015	-.103	-.069	-.172
20-Year Annual Ave.	-$.085	-$ .058	-$ .143
20-Year Totals	-$1.704	-$ 1.151	-$2.855

e. Day Trips from Madison County to Big Sky

The Jack Creek Road would also facilitate increased travel from the Madison Valley to Big Sky. The near proximity of Ennis to the Big Sky Resort could shift many Madison Valley ski trips from the Bridger Bowl Ski Resort to Big Sky. Proximity to the Big Sky ski hill is also likely to cause a general increase in local participation in skiing by Madison Valley residents.

It is also likely that the residents and summertime visitors to the Madison Valley would make non-skiing day trips to Big Sky. Members of the Jack Creek Task Force acknowledged that Ennis residents and summertime visitors would make occasional trips to Big Sky for dining (Jack Creek Task Force Meeting, 1992). This commerce would benefit Big Sky businesses and workers. No estimates for the number of visitor groups or expenditures at Big Sky have been developed.

f. Extending Out-of-State Visits to Montana

Only if expeditures occur which would otherwise not be made in Montana, would the road contribute to a net increase in statewide economic activity. The Big Sky Ski Resort feels its summertime business would be enhanced by more direct access to the tourist attractions of Madison County. The resort feels that some weekday conventioneers would choose to stay over on weekends, because of the nearby accessibility of the Madison's summertime attractions (Taylor Middleton, 1992). Should visitors stay longer and spend more in Montana, these added expenditures would cause net growth in both the Madison County and Gallatin County economies, as well as the statewide economy.

While more convenient access to the attractions of Madison County may be influence a few visitors to stay longer, this increase is not likely to be significant. Big Sky conventioneers already have road access to superior attractions such as Yellowstone Park and the restaurants and shopping of Bozeman. The road would add the Madison Valley to an already compelling list of reasons for extending a Montana visit. No projections of the local or statewide impacts of extended visits have been made.

5. Recreation Home Development

a. Effects of Road on Market for Recreation Homes

Access to Big Sky skiing would add to the amenities which are already attracting construction of retirement and recreational homes in the Madison Valley. If the Jack Creek Road causes additional houses to be built which otherwise would not be built in Montana, it would contribute to net economic growth for the Madison County and statewide economies.

The Ennis area is too far from Big Sky to attract full-blown ski condominium-type development. Ski condominiums are generally within 5 to 10 minutes from a ski hill (Taylor Middleton, 1992) (Alan Vigil, 1992) (Lee Neles, 1992). The wintertime trip from Ennis to Big Sky is estimated to be 30 minutes.

Taylor Middleton of the Big Sky resort feels the road would induce some additional recreational home development in the Ennis area. These homes would be built by people seeking to mix the summertime attributes of the Madison Valley and wintertime skiing at Big Sky. Middleton estimates that an additional 5 new homes per year would be built in the early years of the road's operation and that this would eventually increase to 10 additional homes per year (Taylor Middleton, 1992).

Table B-17 displays assumptions about the number of additional new homes induced by the Jack Creek Road. Five additional houses averaging $100,000 in value would be built in the Madison Valley in 1996. The projections assume that the number of new homes would increase over time.

Table B-17
Additional Home Construction in the Madison Valley
For Selected Years 1995-2015

	Number of New Homes Per Year	Cumulative New Homes
1995	0	0
2000	5	26
2005	6	56
2010	7	89
2015	8	126

b. Employment and Income Effects of Additional Home Construction

Table B-18 displays the projections of the employment and earnings attributable to additional new home development in the Madison Valley. The Ennis area has a well-developed home building industry, and this would serve to increase indirect and secondary economic effects of new home construction.

Table B-18
Economic Impacts of Additional Home Construction
In Madison County
For Selected Years 1995-2015

Annual Increase in Employment in Madison County

	Direct Employment	Indirect & Secondary Employment	Total Employment
1995	0	0	0
2000	8	7	15
2005	9	8	17
2010	10	9	19
2015	11	10	21
20-Year Annual Ave.	9	8	17

Average Annual Increase in Personal Earnings in Madison County
(in millions of 1992 $)

	Direct Earnings	Indirect & Secondary Earnings	Total Earnings
1995	0	0	0
2000	.139	.111	.250
2005	.156	.124	.280
2010	.173	.138	.311
2015	.190	.151	.341
20-Year Annual Ave.	$ .157	$ .126	$ .283
20-Year Totals	$3.147	$2.511	$5.658

c. Economic Impacts of Long-term Population Growth

Table B-19 displays the estimated population impacts of the additional new homes. In time, this population growth could have noticeable impacts on the area's economy.

Table B-19
Additional Population Growth in the Madison Valley
For Selected Years 1995-2015

	New People Per Year	Cumulative Population Increase
1995	0	0
2000	13	62
2005	15	132
2010	16	210
2015	18	296

The new homes would be used during the fishing and skiing seasons. Economic projections assume the recreation homes are occupied 75 percent of the time and the incomes of home occupants come from outside of the local economy.

Table B-20
Economic Impacts of Expenditures by Recreation Home Occupants
In Madison County
For Selected Years 1995-2015

Annual Increase in Employment in Madison County

	Direct Employment	Secondary Employment	Total Employment
1995	0	0	0
2000	0	7	7
2005	0	14	14
2010	0	24	24
2015	0	32	32
20-Year Annual Ave.	0	15	15

Average Annual Increase in Personal Income* in Madison County
(in millions of 1992 $)

	Seasonal Resident Income	Secondary Earnings	Total Income
1995	0	0	0
2000	.536	.099	.635
2005	1.142	.211	1.353
2010	1.961	.363	2.324
2015	2.562	.474	3.036
20-Year Annual Ave.	$1.253	$ .232	$1.485
20-Year Totals	$25.053	$4.635	$29.688

* Seasonal resident income is the portion of the income of occupants of recreation homes that is available to be spent in Madison County.

6. Cross Commerce from Big Sky to Ennis

a. Non Local Expenditures

Commercial businesses in Big Sky are mainly oriented to skiers, tourists, conventioneers, and short-term residents. Big Sky's permanent households travel to Bozeman to make many general retail and personal service purchases. The Jack Creek Road would cause Big Sky households to switch some of their general shopping to Ennis (Taylor Middleton, 1992).

A shopping trip from Big Sky to Ennis would be faster than a trip to Bozeman. Time savings for a trip to Ennis would be about 35 minutes from Mountain Village and 15 minutes from Meadow Village. However, commercial development is more than 30 times greater in Bozeman than in Ennis (U.S. Department of Commerce, Bureau of the Census, 1989). A gravity model analysis indicates these time

savings are not sufficient to switch many shopping trips from Bozeman to Ennis.

Greater variety and better prices in Bozeman will cause it to continue to be the major benefactor of the Big Sky trade irrespective of a Jack Creek Road. A "location quotient" analysis of the Madison County economy indicates that Ennis residents also make significant household purchases in Bozeman. This finding reinforces a conclusion that most Big Sky residents would not switch shopping trips from Bozeman to Ennis. A possible alternative effect of a Jack Creek Road would be to cause Big Sky residents to purchase goods and services in Ennis that they might otherwise buy in Big Sky.

b. Employment and Earnings Effects of Big Sky Household Expenditures in the Madison Valley

Projections assume the Jack Creek Road would result in shift of a small percentage of the expenditures of Big Sky households from Gallatin to Madison County businesses. In 1996, Big Sky residents would spend about $235,000 in Ennis. This expenditure level would be slightly less than 5 percent of the estimated household incomes of the year-round residents of Big Sky.

The purchases of Big Sky residents are predicted to create about five total jobs and about $75,000 in yearly earnings in Madison County. The projections displayed in Table B-21 assume that Big Sky will experience additional development of commercial businesses. As Big Sky becomes more self-sufficient, resident purchases from Ennis businesses would decrease. Commercial development in may eventually develop to a level where it begins to attract general shopping trips by residents of Ennis.

Table B-21
Economic Impacts of Expenditures by Permanent Big Sky Residents in Madison County
For Selected Years 1995-2015

Average Annual Increase in Employment in Madison County

	Direct Employment	Secondary Employment	Total Employment
1995	0	0	0
2000	4	1	5
2005	4	1	5
2010	4	1	5
2015	4	1	5
20-Year Annual Ave	4	1	5

Average Annual Increase in Personal Earnings in Madison County
(in millions of 1992 $)

	Direct Earnings	Secondary Earnings	Total Earnings
1995	$ 0	$ 0	$ 0
2000	.059	.016	.076
2005	.059	.016	.075
2010	.058	.016	.074
2015	.055	.015	.070
20-Year Annual Ave.	$.058	$.015	$ .074
20-Year Totals	$1.165	$ .318	$1.483

c. Impacts on Gallatin County

Household expenditures made in Ennis would take business away from merchants in Big Sky or Bozeman. The transfer of commerce would divert jobs and income from Gallatin County to Madison County.

Table B-22
Economic Impacts of Reallocation of Expenditures of Permanent Big Sky Residents in Gallatin County
For Selected Years 1995-2015

Average Annual Decrease in Employment in Gallatin County

	Direct Employment	Secondary Employment	Total Employment
1995	0	0	0
2000	-4	-3	-7
2005	-4	-3	-7
2010	-4	-3	-7
2015	-4	-3	-7
20-Year Annual Ave	-4	-3	-7

Average Annual Decrease in Personal Earnings in Gallatin County
(in millions of 1992 $)

	Direct Earnings	Secondary Earnings	Total Earnings
1995	$ 0	$ 0	$ 0
2000	-.059	-.046	-.105
2005	-.059	-.046	-.105
2010	-.058	-.044	-.102
2015	-.055	-.042	-.102
20-Year Annual Ave.	-$.058	-$.045	-$ .103
20-Year Totals	-$1.165	-$ .894	-$2.059

7. Increased Drive-through Traffic in Madison County

a. Changes in Travel Patterns

The Jack Creek Road would change travel routes to Big Sky from many western Montana communities. People formerly traveling the Gallatin Canyon (via U.S. Highways 85 and 191) would find it faster to travel U.S 287 to Ennis and then the Jack Creek Road to Big Sky. In-route expenditures formerly made at Belgrade, Gallatin Gateway, Gallatin Canyon and Meadow Village businesses would be switched to Madison County.

Table B-23 displays annual estimates of the number of trips which would be diverted from the Gallatin Canyon to U.S 287. This estimate is derived from skier day estimates developed for the benefit-cost analysis and an assumption that an average of 20 vehicles a day would be diverted to the road during the non-ski season.

Table B-23
Estimated Vehicle Trips Diverted from U.S. 191 to U.S Highway 287
For Selected Years 1995-2015

	Vehicle Trips
1995	0
2000	31,000
2005	35,000
2010	39,000
2015	43,000

b. Employment and Income Effects of Increased Drive-through Traffic in Madison County

Table B-24 displays projections of the economic impacts to Madison County resulting from the additional drive-through traffic. Most of this traffic would occur during the ski season. An assumption is made that each vehicle would spend $1 on its way through Ennis (or one in ten vehicles would spent $10). Purchases mainly would be gasoline, convenience foods, and beverages.

Table B-24
Economic Impacts of Drive Through Travelers In Madison County
For Selected Years 1995-2015

Annual Increase in Employment in Madison County

	Direct Employment	Secondary Employment	Total Employment
1995	0	0	0
2000	1	0	1
2005	1	0	1
2010	1	0	1
2015	1	0	1
20-Year Annual Ave.	1	0	1

Average Annual Increase in Personal Earnings in Madison County
(in millions of 1992 $)

	Direct Earnings	Secondary Earnings	Total Earnings
1995	$ 0	$ 0	$ 0
2000	.008	.003	.011
2005	.009	.004	.012
2010	.010	.004	.014
2015	.011	.004	.015
20-Year Annual Ave.	$ .009	$ .004	$ .013
20-Year Totals	$ .178	$ .074	$ .252

c. Employment and Income Effects of Decreased Drive-through Traffic in Gallatin County

A change in travel routes would transfer the economic benefits of traveler expenditures from Gallatin to Madison County. Businesses in Meadow Village and along U.S. Highways 191 and 85 would experience a decrease in sales to western Montana travelers. Albeit a small change, the effect would be to reduce employment and personal earnings in Gallatin County.

Table B-25
Economic Impacts of the Loss of Drive-through Travelers In Gallatin County
For Selected Years 1995-2015

Annual Decrease in Ski Season Employment and Year-round Equivalent Employment in Gallatin County

	Direct Employment	Secondary Employment	Total Employment
1995	0	0	0
2000	-1	-0	-1
2005	-1	-0	-1
2010	-1	-0	-1
2015	-1	-1	-1
20-Year Annual Ave.	-1	-1	-1

Average Annual Decrease in Personal Earnings in Gallatin County (in millions of 1992 $)

	Direct Earnings	Secondary Earnings	Total Earnings
1995	$ 0	$ 0	$ 0
2000	-.007	-.005	-.013
2005	-.008	-.006	-.014
2010	-.009	-.006	-.016
2015	-.010	-.007	-.017
20-Year Annual Ave.	-$ .008	-$ .006	-$ .014
20-Year Totals	-$ .168	-$ .118	-$ .285

8. Population Impacts

Jack Creek Road would cause additional population growth to occur in the Madison Valley. Some of this additional population growth would result from the new jobs induced by the road. The remainder of the growth would be the occupants of the additional recreation homes which are predicted to be built in the valley. Projections assume that 25 percent of the additional population would live in the Town of Ennis and the remainder would live in unincorporated areas.

Table B-26
Population Impacts of the Jack Creek Road on Ennis and the Madison Valley
2000 and 2010

	Ennis Without Road	Ennis With Road	Mad.Val. Without Road	Mad.Val With Road
1990	773	-	2,018	-
2000	917	1,010	2,393	2,665
2010	1,053	1,211	2,813	3,445

The effects of the road is predicted to add and additional 768 people to the population the Madison Valley between 1996 and 2010. This would increase the valley's rate of population growth from 20 percent to 35 percent per decade.

9. Public Service Impacts

The annual operation and maintenance costs for the Jack Creek Road are estimated to be $125,000. At this time it is unclear which public entity would bear these costs. One reason for recommending a 50-mile per hour road design is that it would have the greatest likelihood of being accepted as a state owned roadway. Otherwise road maintenance cost would likely be borne by Madison County.

The shift of Big Sky traffic from U.S. 287 from Highway 191 would would also cause a corresponding transfer the wear-and-tear on the respective higways. The shifts are not likely to cause appreciable changes in the costs of operating or maintaining the two highways.

Population growth in the Madison Valley would result in increased demand for locally provided public services. Without the road, enrollment in the Ennis school system is projected to increase by 160 students between 1990 and 2010. The Jack Creek Road would add about 150 additional students to the system. The combined effect of ongoing growth trends and growth caused by the Jack Creek Road would be to increase enrollment by 95 senior high school students and by 220 elementary and middle school students.

The existing Ennis High School is sized to accommodate an enrollment increase of up to 100 additional students, so it could handle the projected increases in enrollment. Additional teachers would need to be hired (Jay Willett, 1992). In 1992, the Ennis Elementary School (K-8) has an excess enrollment capacity of only about 25 students (Clare Rasmussen, 1992). Irrespective of the Jack Creek Road, expansion of this school will be necessary in the near future. The development of the Jack Creek Road would serve to increase the scale of the needed expansion and also hasten the time in which the school system will need to take action. The elementary school would also need to further expand its faculty as a result of the Jack Creek Road.

The Ennis water and sewer systems are other major public facilities potentially effected by population growth. The Ennis sewer system is a 3-cell lagoon system with a design capacity of 1,000 population (Scott Anderson, 1992). Without the Jack Creek Road, Ennis's lagoon system will reach its design capacity in 2010. With the road, the lagoon will reach its design capacity by 2000 and expansion would be necessary before 2010.

The Ennis water system is capable of providing high quality service for the town's existing population and the projected growth without the Jack Creek Road (Jim Melstead, 1992). The additional growth induced by the Jack Creek Road could cause need for additional well capacity and water storage by 2010. These improvements could be necessary to meet peak summer demand and to provide for adequate flows for fire protection. Depending on the nature and location of new housing in Ennis, the town's water distribution and sewage collection systems could also need improvements.

The Jack Creek Road would not effect the Ennis Airport. The time savings from the Ennis airport to Big Sky is would not be sufficient to cause skiers to land in Ennis.

Population growth would cause corresponding increases in the demand and costs of general government services provided by the Town of Ennis and Madison County. The growth would also result in an increase in local government property tax revenues. These revenues would primarily result from taxes paid on new houses, although some investment in local businesses would also occur.

The relocation of Big Sky workers and the other new residents working in modest paying service jobs could exacerbate the existing shortages of moderately priced housing in the Madison Valley. The local housing industry is oriented to building more expensive homes than could be afforded by most Big Sky and service sector workers. Increased competition for medium income housing would likely raise sale prices and rents and rent for moderate income housing.

The upper most section of the Big Sky community is located in Madison County. The residents of this area are currently afforded only roundabout access to county government services in located in the Virginia City. The Jack Creek Road would greatly improve these people's access to county government. Likewise, high school age children living in this area would be provided with opportunity to attend school in Ennis in lieu of Bozeman.

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Technical Report 3.

JACK CREEK ROAD BENEFIT-COST ANALYSIS

Table of Contents

A. Introduction 86

B. Benefits of the Jack Creek Road Project 88
  1. Skier trips 88
  2. Other ski season road users 91
    Commuting workers 91
    Winter tourist visits from Big Sky to Ennis . . . 91
  3. Spring season and summer seasons 92
    Commuting workers 92
    Visits to Ennis 92
    Additional Benefits 92
  4. Fall season 92
  5. Other benefits not estimated for this study 93
  6. Total Benefits 93

C. Costs of the Jack Creek Road Project 94
  1. Direct costs 94
    Engineering, design and construction costs . . . 94
    Maintenance and snow removal costs 94
    Adjustment for unemployed resources 94
  2. External costs 94
  3. Present value of total costs 95

D. Net present value of benefits over costs of the Jack Creek Road 95

E. Sensitivity 96

F. Interpreting the results of the benefit-cost analysis . 96
  Geographic perspective 97
  Temporal perspective 98

G. Low-Standard Road Construction Alternative 98

H. Technical Appendix 100
  Skier benefits 100
  Minimum Standard Road Alternative 105
  Commuting workers 105
  Day visits from Big Sky to Ennis 106
  Forecast 107
  Adjustment for Unemployed Resources 108
  Minimum standard construction alternative 111

I. Methodological Appendix: Jobs and Economic Development . 112
J. References 115

List of Tables

1. Effect of Jack Creek Road on 1989 Resident Skier Days . 89
2. 1989 Skier-day Benefits 89
3. Big Sky Skier-day Forecast 90
4. Skier Road Use Benefits 91
5. 1992 NPV of Benefits over Costs 96
6. Jack Creek Road Project Discounted Payback Period . . . 98
7. Ski Area Quality Adjustment Factors 101
8. Allocated Origins of Big Sky resident Skier Days . . . 101
9. Travel Times to Big Sky 102
10. Effect of Jack Creek Road on Resident Skier Days . . . 103
11. Consumer Surplus Associated with Existing Skier Trips . 103
12. Consumer Surplus Associated with New Skier Trips . . . 104
13. Consumer Surplus Associated with Existing Skier Trips O&M Savings 104
14. Minimum Standard Road Alternative 105
15. Big Sky Skier-Days Forecast 107
16. Monthly Unemployment Rates 109
17. Labor Cost Adjustments 110
18. Low Standard Road: 1992 PV of Benefits 111

TECHNICAL REPORT 3
JACK CREEK ROAD BENEFIT-COST ANALYSIS

A. Introduction

The purpose of a benefit-cost analysis is to provide information as to whether a project is worth doing. It is best suited to provide this information from a perspective of economic efficiency, which is promoted when resources are used in the most productive ways. Projects are undertaken only when they are the best means of achieving a desired end, and only when the benefits justify the resources it takes to achieve them.

This study examines the costs and benefits of the proposed Jack Creek Road connecting Ennis, Montana with the Big Sky ski resort. A word is in order concerning what it does and does not measure, and what it should measure.

Road projects are almost always public projects. Part of the reason for this is traditional: streets and highways are publicly owned and maintained. Historically it has been almost impossible to recover the costs of building and maintaining streets and highways by charging users. Of course, there are exceptions such as private logging roads, where the builder is also the beneficiary, and toll roads. Even in cases where users can be charged, there may be external benefits that are not recoverable. For example, a road may provide option benefits due to the possibility of quick access to emergency medical care. A road may also provide general social benefits by integrating communities into the larger society. A road might also provide economic benefits of integrating a community into the larger economy. The presence of beneficiaries who can not be charged to use a project, or the presence of significant external benefits, generally mean government action is required to ensure that adequate resources are devoted to a project.

There are also costs associated with road projects that may be external to the project and not show up in the financial balance sheet of the project. These may include both environmental costs and social costs. While not measured for this study, they may be important and will be referred to later. The presence of significant external costs in a project generally requires corrective action by government to ensure that external costs are avoided or mitigated where it is economic to do so, and that projects are not built for which overall costs exceed benefits.

This benefit-cost analysis for the proposed Jack Creek Road project focuses on the direct benefits and costs of the proposed road. The direct benefits of the road are the benefits to those who use it. The benefits are measured by the "consumer surplus" associated with use of the road, and are primarily measured by the value of time saved by having a shorter route than previously. (Reduced vehicle operating and fuel costs are also estimated.)

It is frequently argued that the business activity attracted to a given location by a road, or the jobs associated with this business activity, are benefits of the road. The desire for economic development is often a driving factor in the promotion of highway projects, and some of the sentiment in Ennis in favor of this project is of this nature (Jack Creek Task Force meeting, March 16,1992). However, many of the benefits that would be seen by Ennis are either offset by losses to other communities or are financial transfers rather than benefits. It is very important to distinguish real benefits from financial transfers. For example, while a gravel pit owner may consider his sales of gravel to a road project to be benefits, the purchases of gravel are costs of the project. Failure to distinguish transfers, and including them with real benefits, result in overstatement of the net benefits to society, and incorrect ranking of projects. Including jobs as benefits in effect offsets the labor portion of a project's costs. This will typically lead to the selection of labor-intensive alternatives over high labor-productivity projects, even though the former may be significantly more expensive. Similar problems will generally follow from the inclusion of transfers as benefits.

The economic effects of the Jack Creek Road on the community of Ennis are projected elsewhere in this report, and are not included in the benefit-cost analysis. Three reasons for this, which may be alluded to here, are:

> (1) Much of the economic activity resulting in Ennis would be activity transferred from other locales, especially the Bozeman area. A benefit accruing to Ennis would be offset by benefits lost to these other locales.
>
> (2) While income received for sales of goods and services to the project may be benefits to the seller, and while jobs on the construction project may be benefits to the workers, from an economic perspective they are part of the cost of the project. The payments for labor and for goods and services are payments to secure resources for the project that could be used elsewhere in the economy. Counting these payments as benefits understates the resource cost of the project, and more generally, leads to incorrect project selection.
>
> (3) A more prosperous community is clearly a gain to society, but it is by no means clear how to measure it. A counting of jobs or of increased community income would be a great overstatement of the benefit, as can be seen by asking how much the community might be willing to pay for the gains.

For these reasons we have not included community benefits in this benefit-cost analysis. They should be weighed, along with the estimated net benefits included and with other unmeasured costs and benefits, in the public decision on whether to commit public resources to the project. A fuller discussion of this issue is

contained in the Methodological Appendix, "Jobs and Economic Development".

B. Benefits of the Jack Creek Road Project

The direct benefits of the road are broken out in this study by the type of user. These include the following groups:

(1) Skiers who currently drive to Big Sky via the Gallatin Canyon who would have a shorter route through Jack Creek.

(2) Additional skier trips induced by the easier access.

(3) Workers at the Big Sky resort who currently commute from Gallatin Gateway, Belgrade or Bozeman but who could live in Ennis and have a shorter commute.

(4) Skiers, conference attendees at Big Sky, or other residents who would have access to Ennis for shopping, dining or touring.

(5) Hunters.

The first group are likely to be the recipients of most of the direct benefits of the project. Benefits are estimated as follows:

1. Skier trips

1989 was the most recent date for which data was available on resident (Montana) and non-Montana skier days at all Montana ski resorts. Resident skier use of Big Sky, as well as at 7 other ski areas, was allocated to various Montana origins by means of a gravity model that was sensitive to age-adjusted population, ski area capacity, travel cost and travel time. Visits from those origins for which travel time would decline with construction of the Jack Creek Road were assumed to increase in a manner consistent with the initial allocation method. Note that the road is assumed throughout to be built to a high standard, with the travel time between Ennis and the ski area assumed to be about 30 minutes. (See the Technical Appendix, below, for detail on the gravity model.)

Table 1, below, presents estimates for use of the Jack Creek Road by Montana skiers driving to and from the Big Sky ski resort.

Table 1

Effect of Jack Creek Road on 1989 Resident Skier Days

Origin	Skier-Days (Current)	Skier-Days (W/ Jack Crk Rd)	Incr.	Jack Creek Rd Skier Trips
Bozeman	13,573	13,573		
Three Forks	1,699	1,699		
Boulder	303	321	19	321
Butte	7,396	8,116	720	8,116
Helena	10,887	11,418	530	11,418
Missoula	1,948	2,135	187	2,135
Great Falls	1,823	1,912	89	1,912
Kalispell	888	931	43	931
Ennis	1,286	1,844	557	1,844
Dillon	1,611	2,040	429	2,040
Livingston	3,697	3,697		
Big Timber	689	689		
Billings	2,873	2,873		
Lewistown	261	261		
Whitehall	626	689	63	689
Total	49,560	52,198	2,638	26,767

Consumer surplus was estimated, in 1992 dollars, as follows: For existing trips that are diverted from other routes to the Jack Creek Road, reduced travel time is valued at $10 per hour. For new trips induced by the shorter travel time, a demand function is assumed that is linear in the relevant segment, and consumer surplus estimated by the area under this segment. (See Technical Appendix for a more information). Additional benefits are reduced vehicle operating costs. These are valued at $0.29 per mile and are credited to the reduced mileage of existing trips diverted to the Jack Creek route. For the 1989 allocation, consumer surplus is estimated as follows:

Table 2

1989 Skier-day Benefits (1992 Dollars)

Source	Amount
Consumer surplus: existing skier-days diverted to Jack Creek	$243,431
Consumer surplus: additional skier-days induced by new road	21,243
Total 1989 consumer surplus	264,674
Vehicle O&M savings	98,505
Total 1989 allocation benefits	363,179

Total skier day data (including both Montana and out-of-state skiers) for the period 1976-1991 were used to construct a forecast of use of the Big Sky ski area in the absence of the Jack Creek Road. This forecast was used to project resident skier use benefits to the year 1996, the assumed year of completion of the Jack Creek Road. After 1996, consumer surplus is escalated at the forecast growth rate for skier visits. Table 3 presents the results of the forecast. (See Technical Appendix for a further discussion of the forecast). As can be seen in table 3, cumulative forecast growth from 1989 to 1996 is 23.67 percent. Accordingly the 1996 skier trip benefits of the Jack Creek Road are escalated by this amount from the 1989 allocation. After 1996 benefits are assumed to grow at the same rate as projected skier-days over the 30 year study period.

Table 3
Big Sky Skier-day Forecast

Year	Actual*	Year	Forecast	Cum. Growth
1974	95,000	1989	167,301	
1975	N.A.	1990	172,959	1.0338
1976	122,000	1991	178,617	1.0676
1977	105,446	1992	184,274	1.1015
1978	116,884	1993	189,932	1.1353
1979	90,710	1994	195,590	1.1691
1980	114,570	1995	201,248	1.2029
1981	92,104	1996	206,906	1.2367
1982	108,146	1997	212,564	1.2705
1983	130,718	1998	218,222	1.3044
1984	136,100	1999	223,880	1.3382
1985	140,007	2000	229,538	1.3720
1986	127,205			
1987	143,793			
1988	162,814			
1989	162,814			
1990	192,004			
1991	213,000			

* Source Taylor Middleton, Director of Marketing, Big Sky

All consumer surplus estimates are in 1992 dollars. Net present value is calculated by discounting future consumer demand at a real discount rate of 3 percent. These discounted benefits are sensitive to the choice of a social discount rate. (See "Total Benefits", below for an indication of the magnitude of this sensitivity.)

Table 4
Skier Road Use Benefits

Total 1989 allocation benefits	$363,179
Estimated 1996 benefits	$449,154
1996 Present value, 30 years benefits	$12.12 million
1992 Present value, 30 years benefits (1996-2025)	$10.77 million

2. Other ski season road users

Other groups of users will benefit from the road. Two of these are commuters, workers for whom the road would make Ennis a more convenient place to live than either Gallatin County or the dormitories at Big Sky; and people who either live at Big Sky or stay there while skiing who would visit Ennis to dine or sightsee. The number of commuters is estimated elsewhere. The benefit received by commuters is assumed to be the difference between a daily commute from either Bozeman or Gallatin Gateway and a commute from Ennis. Tourist and dining visits to Ennis are arbitrarily assumed to be 1 percent of person-days resident at Big Sky. These visits are assumed to be displaced from Bozeman, and the benefit is assumed to be the value of time saved plus reduced vehicle operating cost compared with a round trip from Big Sky to Bozeman.

Commuting workers: Benefits received by Big Sky workers commuting from Ennis are estimated at $181,402 for 1991-92 levels of employment, or $203,680 for 1996, the first year of the project life. The 1992 present value of worker benefits over the 30 year study period is estimated at $4.88 million. (See Technical Appendix for details).

Winter tourist visits from Big Sky to Ennis: Out-of-state skiers staying at Big Sky, as well as Big Sky residents, will make use of the Jack Creek Road to visit Ennis, for shopping, dining or other reasons. The Jack Creek Road is estimated to generate $87,229 in consumer surplus from this population due to reduced driving time to Ennis compared to Bozeman. In addition, assuming 3 people per car, the reduced mileage would generate $34,549 in reduced operating costs. The 1992 present value of benefits over the 30 year project life would be $3.38 million, assuming a 3 percent real social discount rate.

3. Spring season and summer seasons

Use of the road during the spring and summer is assumed to consist of commuter trips of Ennis residents working at Big Sky; visits to Ennis from conventioneers and residents at Big Sky; and occasional tourist drive through trips.

Commuting workers: Benefits for workers commuting the from Ennis for the entire year are included in estimated ski season benefits, above.

Visits to Ennis: Day trip visits from convention attendees and Big Sky residents are arbitrarily assumed to be 1 percent of average spring, summer and fall populations at Big Sky, including convention visitors, vacationers, residents and resident workers. Visits are estimated as in the ski-season Ennis visits. Average daily populations at Big Sky in 1991 were 3155 in the spring, 4543 in the summer, and 3376 in the fall. Outside of ski season, they are assumed to be split 60 percent at the Mountain Village and 40% at Meadow Village. Benefits based on 1991 populations would be $96,930 in reduced travel time and $37,339 in reduced vehicle operating costs, for a total of $134,269. The 1992 present value of benefits, discounted at a 3 percent discount rate over a 30 year study period, would be $3.73 million.

Additional Benefits: Additional benefits would accrue to tourists who would use the road for sightseeing or for a change of pace on their itinerary. The benefits for this group would not be measurable by a decrease in travel time, but rather would have to be assessed by direct survey data on willingness to pay. Sightseeing benefits are not estimated in this report.

4. Fall season

Use of the road in the fall is assumed to consist mainly of commuting workers, included above, and use of the road by hunters. Hunter benefits would consist of improved access to the Jack Creek drainage. Much of the land is in private ownership with uncertain future management. Hunting access is currently allowed under arrangements between Plum Creek and the U.S. Forest Service with limited motorized access points. Plum Creek is trying to sell its Jack Creek holdings, and a future owner would decide on the extent of future access. Therefore the extent of future hunting in the area is uncertain. Illegal hunting would likely increase, but such benefits are probably not relevant to public policy choices.

To the extent that hunters shift their hunting from other areas the net benefit to them would be the value of the improvement in their hunting experience; this would be partially offset by a reduction in the value of the hunting experience to hunters already using Jack Creek, and increased by an improvement to hunters in the areas they formerly hunted due to reduced hunter density in those areas. Because word of hunter success travels quickly it is assumed that hunter pressure would equalize after one or two seasons. The long

term benefit would be an increase in the total hunter capacity of the Madison range. Offsetting this could be a reduction in the elk herd due to habitat loss and interference with migration routes, which would reduce the value of the hunting experience throughout the Madison range.

In addition, it is likely that as elk habitat is compromised through road construction, logging, opening of access roads, wildlife management officials would insist on restricting hunting opportunities, even below current levels, by shortening hunting seasons. This would lead to a direct reduction in "hunter-opportunity-days" (ref. Jim Posewitz, MDFWP).

On balance it is not clear whether the result would be a net gain or a net loss in overall hunter benefits. Because of the uncertainty over the extent to which the area will be accessible, no quantitative estimates were made of net hunter benefits. If such an estimate can be obtained it should be added to the benefits estimates here.

5. Other benefits not estimated for this study

In addition to the benefits discussed above, there may exist other benefits that would accrue from the construction of the Jack Creek Road. For example, it might provide access to emergency medical care for injured skiers in Ennis instead of Bozeman. It might provide faster emergency access to Big Sky by law enforcement or fire suppression personnel. Shifting of traffic from the Gallatin Canyon to the Jack Creek Road might reduce the overall accident rate, as the winter icing conditions along the Canyon route may be avoidable by proper right-of-way selection and design in Jack Creek.

6. Total Benefits

Total direct benefits of the project estimated for this report are the sum of the above benefits to skiers, commuting workers and visitors from Big Sky to Ennis. With a 3 percent discount rate, the sum of estimated benefits for the project, over a 30 year project life, is $22.76 million. To this amount should be added the value of benefits for which no monetary estimates were made. Examples of such benefits are those to hunters and sightseeing tourists; reduced property damage, injury and loss of life due to a possible reduction in motor vehicle accidents; and the value of improved access to Big Sky for emergency vehicles. However, the value of external costs, such as the impact of the road itself and of increased legal and illegal hunter access on grizzly and elk populations, must also be considered. Such values should be subtracted from the benefits of the road, along with direct costs, in arriving at an estimate of the net present value of the road.

C. Costs of the Jack Creek Road Project

Estimated costs of building the Jack Creek Road include engineering costs, right-of-way acquisition costs and construction costs. Once built the road must be maintained. Annual maintenance costs include the costs of snow-removal. Costs were estimated for this study for two levels of construction design. The higher design level is used as a base case here, as it is uncertain whether the Montana Department of Transportation would agree to build and maintain a road through Jack Creek to a lower standard. Nevertheless, the effect of construction to a lower standard is projected as well at the request of members of the Jack Creek Task Force.

1. Direct costs

Engineering, design and construction costs: Construction cost of the Jack Creek Road to high standard is estimated to be $21.5 million in 1992 dollars. Construction is assumed to take place during two construction seasons: April through October in 1994 and 1995.

Maintenance and snow removal costs: Annual maintenance on the Jack Creek Road, including snow removal costs, is estimated to be $124,592 per year in constant 1992 dollars.

Adjustment for unemployed resources: This study is attempting to measure the costs and benefits to society of building the Jack Creek Road. The proper measure of the cost of the road is the opportunity cost of the resources it takes to build them. Generally, with reasonably well functioning competitive markets, the price of a resource is a fair measure of its value in other uses. However if some of the resources used in building the road would otherwise be unemployed, the price may overstate the opportunity cost. There is general agreement among economists that it is appropriate to adjust labor costs for the likelihood of using otherwise unemployed labor. An estimate was made of the appropriate adjustment for this study using a method developed by Haveman and Krutilla, 1968. The adjusted construction cost of the road is $21.29 million, and adjusted maintenance costs are $124,129. (See Technical Appendix for details.)

2. External costs

In addition to the direct costs of building and maintaining the road there may be additional costs imposed by the road. It is helpful to consider these external costs as additional resources that will be committed, along with the concrete and labor and machine time, by a decision to build the road.

Much of the external cost is borne by environmental resources. It is not possible here to do more than allude to them, but they will presumably be the subject of a full Environmental Impact Statement complying with the requirements of both state and federal laws (MEPA and NEPA). Environmental statutes permit, but do not

require, that environmental impact information be placed in a benefit-cost framework. Because such a framework has been created through this study, it would be both relatively easy and highly informative to incorporate the results of an EIS into this analysis.

The major environmental external cost that is likely to result from construction of the Jack Creek Road is interference with wildlife migration corridors and loss of habitat. The species at greatest risk is the grizzly, and it has been suggested that the road would impact grizzly populations in the Madison range. Elk populations may also be affected. If the construction of the road leads to significant additional second home or condominium development in the Madison Valley then additional species such as antelope may be impacted.

A second area where there may be external costs associated with construction of the road is the potential for congestion in Ennis, as all the traffic from western origins to Big Sky must funnel through the main street of Ennis. This study estimates a 1989 allocated skier use of the road of almost 30,000 skier-days. In 1996 this would be around 36,700 skier-days. If most resident skiers are assumed to ski on weekends a typical weekend would see around 410 cars coming through Ennis twice a day. Peak weekends could double that amount, with over 800 additional cars coming through town each morning and each evening. There may be some potential for disruption of traffic flows and brief delays as the traffic passes through Ennis. (A particular bottleneck might be the mini-mart, which now sees congestion on busy summer weekends.) Even a brief delay would affect the projected direct benefits of the project, which come from fairly modest savings of time by large numbers of road users, and would impose delay costs on other residents and visitors in Ennis. The likely affect of peak traffic flows was not estimated for this report, and there is no suggestion of major problems. However, traffic flows could be investigated further in an EIS.

3. Present value of total costs

At a 3 percent social discount rate, the 1992 present value of future costs, with a 1996 construction date, is $22.00 million. To this amount must be added the value of external costs. As discussed above, external costs were not estimated for this report. However, policy makers must judge for themselves an appropriate value to place on any environmental or social costs associated with the construction or the existence of the road but not accounted for in its financial balance sheet.

D.Net present value of benefits over costs of the Jack Creek Road

At a social discount rate of 3 percent the net present value of benefits minus costs that were estimated and valued for this study is estimated to be $0.77 million. To this amount must be added the value of other benefits not quantified for this report, and an

amount subtracted for the value of external costs not quantified for this report.

E. Sensitivity

The choice of an appropriate discount rate has been a matter of much dispute both in public policy debates and in the economics profession. A discussion of the dispute is beyond the scope of this report; the interested reader is referred to Robert Lind, Discounting for Time and Risk in Energy Policy, 1982, for a thorough review. There is some consensus now that the appropriate value is in the 2-4.5 percent range. The Montana Department of Natural Resources and Conservation has in the past used a social discount rate of 4.31 percent, based upon Nordell, 1986. The Bonneville Power Administration and the Northwest Power Planning Council both use social discount rates of 3 percent, The effect of a 0-6 percent range is presented below to indicate the effect of discounting on the estimated benefits. A value of 0 implies future benefits are not discounted; that is, a million dollars of benefits 30 years in the future is worth as much now as a million dollars of benefits now. As will be seen in table 5, below, even the use of a 2 percent discount rate reduces the present value of benefits by almost one third, compared with the undiscounted total benefits over the 30 year study period. The effect on the overall net present value is even greater, a reduction of 61 percent compared with the undiscounted net benefits over the 30 year study period.

Table 5

1992 NPV of Benefits over Costs ($million)

	Real social discount rate				
	0.00	2.00	3.00	4.31	6.00
Skier Benefits	18.82	12.86	10.77	8.65	6.66
Visits	5.91	4.04	3.38	2.72	2.09
Non-ski-season Ennis Visits	6.51	4.45	3.73	3.00	2.31
Worker benefits	8.53	5.83	4.88	3.92	3.02
Total	39.78	27.17	22.76	18.29	14.08
Costs	25.01	22.88	22.00	20.98	19.84
NPV	14.77	4.29	0.77	-2.69	-5.77

F. Interpreting the results of the benefit-cost analysis

Benefit-cost analysis is a tool that helps public decision-makers understand whether the benefits of a proposed project are great enough to justify the costs. The above discussion and estimates of

benefits and costs look at the proposed Jack Creek Road project from the perspective of society as a whole: do the benefits to society as a whole warrant the commitments of society's resources? It asks this question because the benefits will not show up in a demand for the road that would permit a risk-taking developer to build it in expectation of profits. Instead the road must be funded out of public funds raised by taxes and public borrowing, and the beneficiaries do not have to pay to take advantage of it once it is built.

Geographic perspective

It is often argued that benefit-cost analysis should be undertaken with a more limited perspective. For example, it might be argued that a Montana perspective is appropriate. From a Montana perspective, Federal Highway Trust Fund moneys might be viewed as costless. If only the Montana share of construction costs were counted, the present value of costs would shrink considerably and the net present value of the project would rise dramatically. The 1992 value of federal cost-sharing, assuming a 90 percent/10 percent federal-state cost share, and a 3 percent social discount rate, would be $18.33 million. The NPV of the project would appear to rise from $0.77 million to $19.10 million. However, federal funds would be costless to Montana only if they were unlimited. Otherwise federal funds have an opportunity cost represented by the benefits of the best alternate use of the limited funds. While it was not possible to estimate this value for this study, the Montana Department of Transportation may be able to indicate relative values by the priority they place on this project in comparison to other projects and highway improvements that are on the books.

An even more limited perspective might be suggested by a focus on Ennis. From an Ennis perspective, not only are federal funds costless, but so are most state funds. Ennis has only a small percentage of the state's population and a small percentage of its personal income, so the Ennis share of state funds required by the project is very low. The travel benefits to skiers from outside Ennis and Madison County would not be seen as local benefits. However, many factors treated as costs to the project might be seen as benefits by the local business community. Salaries received by local workers on the project, sales of goods and services to contractors and workers, would be seen as sources of additional profits by local businesses. Further, Ennis business would see business volumes increase due to the increase in winter traffic and motel demand. However, most of the business that would accrue to Ennis would be a transfer from business previously received by other places such as Bozeman. A local perspective would ignore the losses elsewhere and count only the local benefits. Such a perspective would clearly overstate the desirability of the project.

Temporal perspective

This study projects the benefits of the project for a 30 year study period. While a road such as the Jack Creek Road would be in place indefinitely, providing benefits and shaping the development and use of the area, projections of benefits become increasingly problematical the further one looks into the future. For long-lived projects, therefore, decisions will be more robust the shorter the payback period. That is, if one can truncate the analysis period and still show a favorable NPV, one has greater assurance that the project will be worth doing even if one has overestimated the long-term benefits.

A measure of the robustness of the Jack Creek Road project, therefore, is given by table 6, showing the payback period for various discount rates.

Table 6

Jack Creek Road Project Discounted Payback Period

Social discount rate	Discounted Payback Period
0.00	20 years (2015)
2.00	25 years (2020)
3.00	29 years (2024)
4.31	>30 years
6.00	>30 years

G. Low-Standard Road Construction Alternative

At the request of members of the Jack Creek Road Task Force, this study examined the costs and benefits of building a road from Ennis to Big Sky at a lower standard. Such a road would still provide year-round paved access to Big Sky, but would have steeper grades and sharper curves, and would have a lower construction cost. It would also sustain slower safe driving speeds, and consequently would not provide the same benefits because the savings in travel time would be lower.

The estimated construction cost to the lower standard is $17.0 million. Annual operating costs, including snow removal, are estimated to be $110,500 per year. After adjusting for the use of unemployed labor, construction cost is projected to be $16.83 million and maintenance costs are $110,068.

Because this alternative would save less travel time, the number of additional skiers induced by the road would be lower. The gravity model indicates an additional 1,483 skier-days would be induced, compared with an additional 2,638 skier-days induced by the high standard road.

Consumer surplus benefits to skiers would be reduced, partly because the total number of users would decline slightly, but

mainly because the reduction in travel time is lower for all trips captured by the Jack Creek route. Skier benefits, based on the 1989 allocation of resident skiers, are estimated at $247,376. This compares with skier benefits of $363,179 with the high standard road.

Commuting worker benefits would also be reduced, because the saving in travel time compared with commuting from Bozeman or Gallatin Gateway would be less with the low standard road. Worker benefits would be $111,280 (based on 1991 work force levels). The high standard road provides equivalent worker benefits of $181,402.

Benefits associated with day visits from Big Sky to Ennis would also be lower, both in ski season and during the rest of the year. Ski season visit benefits would be $93,913 (down from $121,778). Benefits from day visits the rest of the year would be $103,659 (down from $134,269).

With a 3 percent discount rate, the 1992 present value of benefits would be $15.82 million. The 1992 present value of construction and maintenance costs for the low standard road would be $17.61 million. the net present value of the low standard road would be negative: -$1.79 million over the 30 year study period. The discounted payback period would be greater than 30 years (after 2025). Of course, the same caveats would apply to these figures regarding additional benefits and costs that were not estimated for this study.

Technical Appendix

Skier benefits

Montana skier days account for about 40 percent of total use at Big Sky (Montana Travel and Tourism Statistics Sourcebook: 1980-89). There is no data on the origins of Montana skiers at Big Sky or at other Montana ski resorts. Therefore a gravity model was designed to allocate resident skiers to Montana points of origin. A variety of assumptions embodied in gravity models were tried to allocate Montana skiers.

The gravity model was designed following the general procedure used in the Brighton study in Utah (*Technical Report on the Economic Analysis of the Brighton Ski Area Master Plan*, Utah Office of Planning and Budget, 1991). The major factors that enter into the model finally chosen are the capacity measure of the ski area, measured by the total lift capacity in skier-feet per hour; the population of the origin area, adjusted for age distribution; the cost of lift ticket and, when relevant, overnight lodging; and travel time. Each variable enters with a functional form set to yield a reasonable allocation of skiers to locations. Thus, attraction factors for each origin and destination are adjusted by a scale factor to ensure total skier days match the historical total for the state, and quality adjustments are set for each ski area to match visits to historical data for that area. The general form of the gravity model is as follows:

$$S_{ij} = A*q_j*cap_j{}^{k1}*pop_i{}^{k2}*cost_{ij}{}^{-k3}*e^{-k4*timeij}$$

where S_{ij} = skier days from origin i at area j
A = scale factor
q_j = quality adjustment for area j
cap_j= lift capacity at area j
k1 = coefficient for influence of capacity
pop_i= age-adjusted population for origin i
k2 = coefficient for influence of population
$cost_{ij}$=lift ticket price at area j, (plus $50 for origins with travel time > 3 hours)
k3 =coefficient for influence of cost
$time_{ij}$=travel time from origin i to area j
k4 =coefficient for influence of travel time

The coefficients (k1, k2, k3 and k4) were chosen to minimize the importance of the quality adjustments (q_j), to ensure that the gravity factors themselves did a good job of predicting visits for all areas. This was done by trying to minimize the sum of squared deviations from one. Values for the base case estimates are given below.

A = 21.29325
k1 = 1
k2 = 1
k3 = 2.1
k4 = 0.2

Quality adjustment factors for the base case are as follows:

Table 7
Ski Area Quality Adjustment Factors

Ski area	index	q_j
Big Sky	q_1	1.010953
Bridger	q_2	1.182549
Red Lodge	q_3	0.600982
Snow Bowl	q_4	0.982544
Big Mtn	q_5	1.049655
Gt Divide	q_6	0.709160
Discovery	q_7	1.378193
Showdown	q_8	1.267401

The number of skiers per car is not relevant to travel time savings because the estimated reduction in travel time is the same. Savings in fuel and operating cost depend on the number of vehicles, not skiers. For this reason we assume an average of three skiers per car.

With these assumptions, the 49,560 resident Montana skier-days at Big Sky are estimated to be allocated as follows:

Table 8

Allocated Origins of Big Sky resident Skier Days

Origin	Pct of Total	Skier-Days
Bozeman	0.274	13,573
Three Forks	0.034	1,699
Boulder	0.006	303
Butte	0.149	7,396
Helena	0.220	10,887
Missoula	0.039	1,948
Great Falls	0.037	1,823
Kalispell	0.019	888
Ennis	0.026	1,286
Dillon	0.033	1,611
Livingston	0.075	3,697
Big Timber	0.014	689
Billings	0.058	2,873
Lewistown	0.005	261
Whitehall	0.013	626

For each year after the road is built, estimated skier trips are calculated with and without the road for each point of origin. Skiers who would travel in the absence of the road benefit by the full value of the reduction in travel time. Additional skier days evoked by the lower travel time benefit by the increase in consumer surplus. This is the area under the declining demand curve, and is estimated by one half the additional skiers times the saving per skier times the value of time. Total savings are twice the above to account for return trips. Fuel and O+M savings are estimated only for skiers diverted from longer routes, dividing the number of skiers by three to get the number of vehicles, and multiplying miles saved by 29 cents per mile. Annual benefits are discounted to 1992.

Table 9

Travel Times to Big Sky (Hrs.)

Origin	Current	With Jack Creek Road
Bozeman	1.12	1.12
Three Forks	1.43	1.43
Boulder	2.27	1.97
Butte	2.25	1.78
Helena	2.63	2.39
Missoula	4.07	3.61
Great Falls	4.00	3.76
Kalispell	6.19	5.95
Ennis	2.30	0.50
Dillon	2.97	1.79
Livingston	1.52	1.52
Big Timber	2.06	2.06
Billings	3.70	3.70
Lewistown	3.91	3.91
Whitehall	1.87	1.39

Table 10

Effect of Jack Creek Road on Resident Skier Days

Origin	Skier-Days (Current)	Skier-Days (With Jack Crk Rd)	Increase
Bozeman	13,573	13,573	
Three Forks	1,699	1,699	
Boulder	303	321	19
Butte	7,396	8,116	720
Helena	10,887	11,418	530
Missoula	1,948	2,135	187
Great Falls	1,823	1,912	89
Kalispell	888	931	43
Ennis	1,286	1,844	557
Dillon	1,611	2,040	429
Livingston	3,697	3,697	
Big Timber	689	689	
Billings	2,873	2,873	
Lewistown	261	261	
Whitehall	626	689	63
Total	49,560	52,198	2,638

Table 11

Consumer Surplus Associated with Existing Skier Trips

Origin	Shifted Trips	Travel Time Saving (One Way)	Consumer Surplus
Bozeman			
Three Forks			
Boulder	303	0.30	$ 1,820
Butte	7,396	0.46	68,684
Helena	10,887	0.24	51,772
Missoula	1,948	0.46	17,870
Great Falls	1,823	0.24	8,668
Kalispell	888	0.24	4,223
Ennis	1,286	1.80	46,302
Dillon	1,611	1.18	38,069
Livingston			
Big Timber			
Billings			
Lewistown			
Whitehall	626	0.48	6,022
Total	26,768		$243,431

Table 12

Consumer Surplus Associated with New Skier Trips

Origin	New Trips	Travel Time Saving (One Way)	Consumer Surplus
Bozeman			
Three Forks			
Boulder	19	0.30	$ 56
Butte	720	0.46	3,342
Helena	530	0.24	1,261
Missoula	187	0.46	859
Great Falls	89	0.24	211
Kalispell	43	0.24	103
Ennis	557	1.80	10,032
Dillon	429	1.18	5,075
Livingston			
Big Timber			
Billings			
Lewistown			
Whitehall	63	0.48	304
Total	2,638		$ 21,243

Table 13

Consumer Surplus Associated with Existing Skier Trips O&M Savings (3 Skiers per Vehicle)

Origin	Shifted Trips	Mileage Saving (One Way)	Consumer Surplus
Bozeman			
Three Forks			
Boulder	303	19	$ 1,111
Butte	7,396	24	34,118
Helena	10,887	4	8,420
Missoula	1,948	24	9,037
Great Falls	1,823	4	1,410
Kalispell	888	4	687
Ennis	1,286	91	22,628
Dillon	1,611	57	17,749
Livingston			
Big Timber			
Billings			
Lewistown			
Whitehall	626	26	3,146
Total	26,768		$ 98,505

Minimum Standard Road Alternative Under the alternative design for the Jack Creek Road, the travel time from Ennis to Big Sky would be 42 minutes (0.70 hours). The reduction in travel time would be less for all points of origin. Because of this, the number of additional skier-trips induced by the road would be lower, and while the number of shifted trips would not change, the consumer surplus benefits would decline for all trips. Table A8 indicates the consumer surplus benefits to skiers under the Minimum Standard Alternative. There is no change in vehicle maintenance savings. They are a function of mileage savings and only apply to shifted trips, neither of which changes.

Table 14

Minimum Standard Road Alternative
Consumer Surplus

Location	Orig Skier days	Rvs'd Skier days	Shift	Increase	Consumer Surplus (Dollars)
Bozeman	13573	13573	0	0	0
Three Forks	1699	1699	0	0	0
Boulder	303	309	303	6	614
Butte	7396	7797	7396	401	40,118
Helena	10887	10969	10887	82	8,192
Missoula	1948	2051	1948	103	10,335
Great Falls	1823	1837	1823	14	1,372
Kalispell	888	895	888	7	668
Ennis	1286	1771	1286	485	48,908
Dillon	1611	1960	1611	349	35,046
Livingston	3697	3697	0	0	0
Big Timber	689	689	0	0	0
Billings	2873	2873	0	0	0
Lewistown	261	261	0	0	0
Whitehall	626	662	626	36	3,617
Totals	49560	51043	26767	1483	148,871

Commuting workers

A gravity model was used to allocate commuting workers' residential origins. Currently workers are assumed to commute from the Bozeman/Belgrade area or the Gallatin Gateway area. The gravity model assigns about 61 percent to Bozeman/Belgrade and 31 percent to Gallatin Gateway. The construction of the Jack Creek Road would allow workers to live in Ennis, a much shorter commute. As with skier benefits described above, the benefits received by workers would depend on their savings in time and distance. Unlike skiers, however, a significant portion of the work force works in the Meadow Village area. The savings for these workers is less than for workers at the ski resort.

The 1991-92 employment at Big Sky is estimated at 910 in the winter (of whom 80 percent, or 728, worked at the ski area), and 663 the rest of the year (of whom 60 percent, or 398, worked at the ski area). The annual average employment was 508 at the Mountain Village, and 237 at Meadow Village. The gravity model estimates that, with the Jack Creek Road in place, an average of 76.6 workers would have commuted from Ennis. Of these, 52.2 would have commuted to the Mountain Village and 24.4 to Meadow Village.

The time savings for a Bozeman/Belgrade resident working at the Mountain Village who relocates to Ennis would be 0.62 hours each way. Assuming five round trips per week for 50 weeks and a value of $10 per hour for saved time, this worker would receive a benefit of $3100/year. Car mileage would go down by 26 miles per trip. Assuming operating costs of 29 cents/mile and 2 workers per car, the average worker would also receive a benefit of $377/year in reduced vehicle operating costs.

A former Gallatin Gateway worker at the Mountain Village would receive increased consumer surplus estimated at $1800/year and reduced vehicle costs of $174.

A former Bozeman/Belgrade resident working at Meadow Village would receive increased consumer surplus estimated at $2000/year and vehicle savings of $203.

A former Gallatin Gateway resident working at Meadow Village would receive increased consumer surplus estimated at $750/year and no vehicle savings.

Total benefits associated with shorter worker commutes are estimated at $181,402/year at 1991-92 levels of employment. No data was available to permit separate forecasts of non-winter activity at Big Sky. Therefore, for this study, average annual employment was assumed to grow at the same rate as forecast skier-days. Growth in employment associated with forecast increases in skier-days at the resort results in 1996 benefits received by Big Sky workers commuting from Ennis estimated at $203,681. The 1992 present value of worker benefits over the 30 year study period is estimated at $4.88 million.

Minimum Standard Road Alternative Benefits

Under the minimum standard alternative 74 workers would relocate to Ennis. Because of the increased travel time from Ennis to Big Sky, there would be no benefit to workers at Meadow Village relocating from Gallatin Gateway. Accordingly, all the relocating Gallatin Gateway workers were assumed to work at the Mountain Village. Total worker benefits were estimated to be $111, 280, with a 1992 present value of $3.00 million.

Day visits from Big Sky to Ennis

Ski season: In the absence of any direct evidence, it was assumed that Ennis visits would be 1 percent of the person-days resident at

Big Sky. These visits to Ennis are assumed to replace trips to Bozeman. Accordingly the savings are time and reduced vehicle operating cost, between visits either from the Mountain Village or Meadow Village to Bozeman and to Ennis. The 1991 average daily population at Big Sky during the ski season was estimated to be 6310, split 80 percent at the Mountain Village and 20 percent at Meadow Village. The Jack Creek Road is estimated to generate $87,229 in consumer surplus from this population due to reduced driving time to Bozeman. In addition, assuming 3 people per car, the reduced mileage would generate $34,549 in reduced operating costs. Escalated to 1996 these values are $101,044 and $40,021 respectively. The 1992 present value of benefits over the 30 year project life would be $3.38 million, assuming a 3 percent real social discount rate.

Remainder of year: The 1991 average daily population at Big Sky during the spring was 3155; during the summer it was 4543; and during the first two months of fall it was 3376. (The average for these months is 3734.) Total person-days resident at Big Sky outside of ski season is therefore estimated to be 910,997. These are assumed to be split differently than ski season, with 60 percent resident at the Mountain Village and 40% at Meadow Village. Following the assumptions above, total visits to Ennis for the season would be 9110, with 5466 driving from the Mountain Village and 3644 from Meadow Village. Consumer surplus for these trips, based on shorter driving time than to Bozeman, is estimated at $96,930. Vehicle operating savings generate an additional $37,338 in benefits. Escalated to 1996 these values are $112,282 and $43,252 respectively. The 1992 present value of benefits would be $3.73 million.

Forecast

Forecasts were based on data on historic use of the Big Sky ski area and snow conditions. A variety of functional forms were tried, with the final forecast based upon a simple model based on January snowpack and time. Table A9 presents the results of the forecast.

Table 15

Big Sky Skier-Days Forecast

$$\text{Skier-days} = a + b_1 * t + b_2 * \text{Jan snowpack}$$

```
                    Regression Output:
Constant                          46659.32
Std Err of Y Est                  16526.35
R Squared                         0.800676
No. of Observations                     17
Degrees of Freedom                      14

X Coefficient(s)  5657.880 1017.423
Std Err of Coef.  803.1698 475.1617
```

January snowpack was a better estimator than February, March or April. Use of all 4 months of snowpack data with dummy variables improved the R^2 to .86, but none of the individual snowpack coefficients were significant.

Adjustment for Unemployed Resources

The unemployed worker adjustment is based on a method developed in Haveman and Krutilla, Unemployment, Idle Capacity, and the Evaluation of Public Expenditures, (Resources for the Future, 1968).

If labor markets were not sticky and there were unemployed workers available, a new project would result in a one-for-one reduction in unemployment. Assuming away productivity differences among workers, the opportunity cost of using labor on the project would therefore be zero. On the other hand, use of wages to measure opportunity cost assumes that all hires for a new project reduce productivity somewhere in the economy by the full value of the wage.

The logic of the Haveman-Krutilla (H-K) adjustment is that labor markets are sticky. Unemployment may persist in the face of new demand for workers, hence when a project is hiring workers there may be some ultimate reduction in unemployment but some portion of workers will shift from productive employment, resulting in productivity losses in other sectors of the economy. H-K assume that there is some full employment level in the economy, h^f, below which all new hires are displacement and there is no reduction in unemployment. On the other hand, there is some high level of unemployment, h^*, at which all hires are replaced with unemployed labor, and the adjustment is 100 percent. H-K use a value of 29 percent, the level of unemployment prevailing during the great depression, as their measure of h^*. the base, or full employment rate h^f, used in this study is 4.3 percent. This is the 1970 Montana unemployment rate, the lowest rate observed in recent history.

Monthly data on unemployment in the construction industry in Montana is not available. Annual average unemployment in the industry is extremely high. The most recent three year available are 1988, 1989 and 1990; average unemployment in the industry was 23.2 percent, 19.1 percent, and 17.9 percent, respectively. However, annual averages are not likely to be useful for purposes of this adjustment, because the off season rates are very high, while unemployment during the construction season is likely to be much lower. Accordingly a synthetic unemployment profile was created for the study. The profile took as its starting point the 1990 monthly unemployment figures for all industries for the state. It was assumed that construction industry rates would be the same as statewide rates for the months of May through October. The standard deviation of average monthly rates around the annual average was escalated for the construction industry until rates for January through April, and November and December, were such that the average for the year was 17.9 percent. Table A10 provides this

calculation. Note that for those months where projected unemployment rates were above 29 percent, they were set at 29 percent for purposes of calculating the adjustment factor.

Table 16
Monthly Unemployment Rates

	Montana Rates					Simulated Construction Unemployment Rates
Ann Avg	5.8	6.9				
Month	1990	1991	Dev	StdDevs		
J	5.9	7.6	0.7	3.17	30.7	29.0
F	5.9	7.7	0.8	3.62	32.6	29.0
M	5.7	8.5	1.6	7.25	47.2	29.0
A	5.3	6.6	-0.3	-1.36	12.4	12.4
M	5.3	6.4	-0.5	-2.26	5.3	5.3
J	5.3	6.5	-0.4	-1.81	5.3	5.3
J	5.0	6.3	-0.6	-2.72	5.0	5.0
A	4.6	5.9	-1.0	-4.53	4.6	4.6
S	5.8	6.2	-0.7	-3.17	5.8	5.8
O	6.3	6.6	-0.3	-1.36	6.3	6.3
N	6.8	7.7	0.8	3.62	32.6	29.0
D	6.9	7.4	0.5	2.26	27.1	27.1
	Std Dev		0.221	Avg	17.9	

The H-K adjustment factor P is calculated at follows:

$$P=1-.5[\sin(\Pi\frac{h-h^{f}}{h^{*}-h}-\frac{\Pi}{2})+1]$$

Adjusted costs are calculated by multiplying the estimated monthly labor cost by the monthly adjustment factor. Table A11 presents the monthly adjustment factors and revised construction cost estimates.

Table 17

Labor Cost Adjustments
High Standard Construction Alternative

Month	Unemployed Labor Adjustment	Monthly Construction Labor Cost ($ m)	Adjusted Labor Cost ($ m)
Jan	0.000	0.000	0.000
Feb	0.000	0.000	0.000
Mar	0.000	0.000	0.000
Apr	0.757	0.384	0.291
May	0.996	0.384	0.382
Jun	0.996	0.384	0.382
Jul	0.998	0.384	0.383
Aug	1.000	0.384	0.384
Sep	0.991	0.384	0.380
Oct	0.984	0.384	0.378
Nov	0.000	0.000	0.000
Dec	0.015	0.000	0.000
Annual		2.69	2.58
Total Labor Cost		5.38	5.16
Total Project Cost		21.50	21.29
Annual Cost		10.75	10.64

Minimum standard construction alternative

The minimum standard construction alternative results are presented in table A12, below.

Table 18

Low Standard Road

1992 PV of Benefits ($million)

Real social discount rate

	0.00	2.00	3.00	4.31	6.00
Skier Benefits	12.82	8.76	7.34	5.89	4.54
Visits	4.56	3.11	2.61	2.10	1.61
Non-ski-season Ennis Visits	5.03	3.44	2.88	2.31	1.78
Worker benefits	5.23	3.58	3.00	2.41	1.85
Total	27.64	18.88	15.82	12.71	9.78
Costs	20.90	18.58	17.61	16.48	15.21
NPV	7.51	0.54	-1.79	-4.06	-6.05
Payback	2018	2025	>2025	>2025	>2025

Methodological Appendix: Jobs and Economic Development

A major reason for the interest in the Jack Creek road comes from the expectation that it will be a major development impetus for Ennis. This expectation assumes that improved access to Big Sky will result in a significant demand for accommodations, including both motel and condominium developments, in the Madison Valley. There has been speculation that once the road is in place, improvements to the Ennis airport will result in a capture of a significant part of the air traffic to Big Sky.

From the perspectives of Ennis and Madison County, the project is very likely to have a favorable ratio of benefits to costs, because the direct project costs would be paid largely with federal and state funds, even if the project attracts business that previously went to Gallatin County businesses. Thus even though most benefits to Madison County are transfers from other areas the project would still look favorable from a Madison County perspective. The same argument might be made for the state as a whole, since most highway projects are funded largely with federal funds. However federal highway funds are not available in unlimited amounts, but are in very short supply. Therefore the use of federal monies on the Jack Creek project carries an opportunity cost amounting to the foregone benefits of the best project it would displace. However, even if there were no displacement of other projects, because a separate congressional appropriation were made for the project, consideration should still be given to the full benefits and costs to society. No matter how favorable the project looks from a Montana perspective, it will have a better chance of funding and of withstanding public scrutiny if it can meet a societal benefit-cost test that does not depend on outside subsidy.

The concern over jobs and development is recognized in this study in two ways. First, this study estimates the economic impact of the construction of the road on Madison and Gallatin Counties as well as on the state as a whole. Second, the study projects future development in the Madison Valley related to the improved access to Big Sky provided by the Jack Creek Road. However, these estimates are not part of the benefit-cost analysis. For several reasons it would be improper to add estimates of the direct, indirect and induced income and employment effects to the benefit side of the benefit-cost calculation.

Consider first the major reason for conducting a benefit-cost analysis. The major reason is that, in the absence of a private market for road services, the public is asked to build the road, and the benefit-cost analysis is intended to shed light on whether it is worth devoting society's resources to the project. Therefore the focus is on the resource, as opposed to the financial, costs of the project. Similarly the benefit side must focus on real benefits, not on financial benefits and not on transfers. The income and employment effects on Ennis and Madison County are part of the financial mirror of the resource use of the project. While income and employment may be beneficial to the recipients, they are

costs to the project. Further, payments to suppliers and to labor are used in the benefit-cost analysis as measures of the opportunity cost of those resources. That is, the use of resources on a project precludes their use elsewhere in the economy, and therefore loses the benefit of their output when they are so used. Treatment of these payments as benefits would fail the test of making the overall analysis measure the net value of the project to society.

The consequences of such treatment can be extrapolated. Treating jobs as benefits in effect would wipe out the labor component of project costs, and generally would lead to a selection of labor-intensive projects and technologies over capital-intensive ones, despite overall higher cost. A result would be excessive costs to consumers, a failure to invest in new, more labor-productive equipment and technologies, and a loss of competitiveness for the economy.

In a well functioning market economy (which, despite their problems, the U.S. and Montana econmies are), opportunity costs are reasonably well measured by factor prices, such as the wage costs of labor and the prices paid for materials and other services.

To the extent that labor on the project would otherwise be unemployed, most economists agree that an adjustment to the wage costs would be appropriate (see, for example, Gramlich, 1981; Mishan, 1976; Sassone and Schaffer, 1978; and Water Resource Council, 1983). However, to count jobs, or incomes received from the project, as benefits, is in effect to count them as free of opportunity cost for the project. This is clearly not the case.

A second reason why income and employment effects are not benefits to be included in benefit-cost analysis that these measures may drastically overstate even the benefits as viewed by the recipients. One way to determine the extent something is a benefit is to ask whether, and how much, the recipient would be willing to pay for it. Clearly an Ennis worker on a road project would not be willing to pay his salary to get the job. The payroll clearly overstates the benefit to workers receiving the jobs. The most workers might be willing to pay would be the value of the difference between the job and the next best thing they would be doing. This measure is closely equivalent to the adjustment for unemployed labor discussed above. Even if workers received higher pay on project-induced jobs than they previously earned, their former employers may have to hire less-skilled workers to replace them. The opportunity cost to society of using those workers on the project may be higher or lower than their new wages, and net benefits might be positive or negative. (Similarly, local suppliers would not be willing to pay the amount of their margins on sales to the project.)

In sum, socio-economic impact analysis is designed for a different purpose than benefit-cost analysis, and the results of the two analyses cannot be added together. Benefit-cost analysis is a microeconomic tool useful for project selection and project

evaluation. Socio-economic analysis is more of a macroeconomic tool useful for projecting employment and income levels, tax receipts and the demand for public services. Both tools provide valuable information, but they should not be confused or mixed together.

In the same way, one must take care to avoid double counting of benefits when assessing external economic benefits. Thus, the usual measure of direct benefit of a project is the consumer surplus received by users of the project. To count in addition the benefits they receive because of the project, which are the reasons that they use it, would be incorrect. For example, some additional skier trips will be induced by the Jack Creek Road. The direct benefit these additional skiers receive is the consumer surplus associated with the reduced travel time. The benefit they derive from skiing should not be counted as well; it that benefit that creates the demand for travel.

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